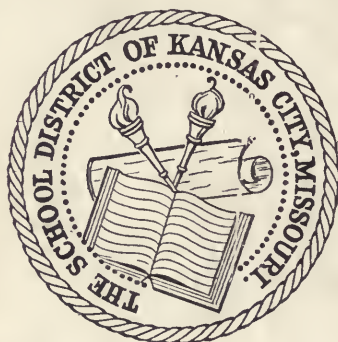


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San Francisco, California
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THE IRRIGATION AGE.

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IRRIGATION TRUSTS IN VICTORIA.*

CHAPTER II. NATIONAL WORKS.

MAY 17 BY FRED CAMPBELL, C. E.

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IT has been stated in the preceding paper that when a scheme for establishing a trust or trusts came before Parliament, certain portions of the proposed works, on the recommendation of the Minister for Water Supply and his technical advisers, could be denominated "national works;" these would then be constructed at the cost of the State. It is now proposed to describe these works.

In comprehensiveness of design, in magnitude of works and in area of irrigated land commanded, the Goulburn Weir comes easily first. The Goulburn, a tributary of the Murray, is the largest of the Victorian rivers, and takes its source in high mountainous country, some of the peaks reaching an altitude of 5,000 and 6,000 feet. The area of its watershed above the weir is 3,940 square miles, and as the bed rock, a dense, close-jointed schist, lies near the surface over a large extent of the watershed, the proportion of total rainfall discharged into the river is large. The river basin below the weir comprises a further area of 2,500 square miles, and is composed of alluvial plains of deltaic origin. The weir is constructed just above where the country changes to alluvial flats from low ranges, and it was to provide a steady water supply to the rich deltaic flats during summer droughts that induced the state to undertake this large work. From careful observations of rainfall and river gaugings carried out over a period of nine years, it has been ascertained that the proportion of total rainfall over the catchment area,

passing the site of the weir, varied between 18 per cent and 37 per cent, the average having been 29 per cent.

Various reports from the Department of Water Supply were presented to Parliament, on the construction of a storage basin and regulating weir on the Goulburn river, and finally, in 1886, Parliament authorized its construction. By the middle of the following year a contract had been let and work commenced.

DESCRIPTION OF THE WORKS.

The rock, forming the foundation of the weir and extending under the bed of the river and up both banks at a small depth below the surface, is a soft shale of the upper silurian formation. Its structure is alternating beds of sandstone, slate and pipeclay, standing on edge almost vertically. The weir is 695 feet in length, exclusive of the space occupied by channel regulators—a further length of 230 feet—and the summer level of the river is raised by it about 45 feet.

The main part of the structure is of concrete masonry, composed of broken stone, clean washed gravel, sharp sand and Portland cement. It is backed by granite steps for its full height and notched into that below. While the superstructure was in progress, the water was carried by six tunnels left in the lower portion, each of forty-four square feet section area. These were permanently closed by heavy cast-iron gates, when the upper works had been completed. During the course of the works a heavy flood totally submerged them, but without doing any damage.

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The weir is built of large blocks of concrete bonded as in ordinary masonry and laid in cement mortar. This course was adopted in preference to the ordinary method, as it was considered that should a crack start, there would be less danger of it traversing the structure from top to bottom than were it monolithic.

The waterway in the upper portion of the weir is occupied by twenty-one flood-gates, each having a clear opening of twenty feet by ten feet. These are lowered into recesses or chambers in the body of the work, and can be so adjusted at any time as to maintain a constant level of water in front of the offtakes. Wrought iron ribs and braces have been worked into the concrete in front of the gate chambers to strengthen it at these points.

The gates which are framed of wrought iron beams filled in with cast-iron plates, each weighing about seven tons, are worked by screw gearing. The gate pillars are of cast iron, hollow and filled with concrete. They are strongly secured by anchor plates and holding down bolts, and occupy about two feet of the waterway. The gearing for raising and lowering the gates is actuated by three thirty and a half inch "Leffel" turbines. These can be worked together or separately, and anyone or all three can be put in gear with any gate or gates. Hand gearing is also provided in case of emergency. A separate turbine drives generating machinery for electric light consisting of five arc lamps. These are necessary in order that the gates may be adjusted at night should the height of the river fluctuate.

REGULATORS.

In continuation of the weir are two regulators for the channel offtakes, one on the east and one on the west. These are of similar construction to the weir and are provided with cast-iron gate standards which also carry a light bridge. The western regulator has fourteen gates, each nearly ten feet clear opening with a height of seven feet. The eastern regulator has only four gates of similar dimensions.

CHANNELS.

In connection with the weir, a channel upward of twenty miles long has been excavated, from which the trusts to the west of the Goulburn river derive their supply. The bottom width of this chan-

nel is 110 feet and side slopes of one and a half to one. The gradient is six inches per mile, and it has a carrying capacity of 103,400 cubic feet per minute when running full. The eastern channel has not yet been constructed; it will be of much less capacity than the western. When both channels have been constructed it is estimated that 125,000 cubic feet per minute can be sent down during five months of the year, and assuming the construction of certain subsidiary storage basins, a total area of 416,000 acres can be irrigated to a depth of fifteen inches, after allowing a large margin for evaporation and infiltration.

COST.

The total expenditure on this splendid work to date has been £491,000 (\$2,455,000). Maintenance expenses come out at about £2,500 (\$12,500) a year. Part of this sum has been used in lining portions of the channels which are of earth. Indeed, maintenance charges should be a minimum on a work of this substantial character.

The foregoing description has been largely taken from a descriptive memorandum of the weir, compiled by the Chief Engineer of Water Supply, Mr. Stuart Murray, under whose supervision the works were designed and executed.

LAANECORIE WEIR.

This weir is situated on the Loddon river about half a mile above the township of Laanecoorie, and is for the purpose of impounding and regulating the flow of water in that stream. No channels are in direct connection with the weir, which is solely used for regulating the supply in the river bed itself, the offtakes to the trusts' channels being some twenty miles lower down. Six trusts are dependent on the water here conserved for their supply.

DESCRIPTION OF WORKS.

The portion of the structure in the river channel itself is of concrete, with automatic lifting gates for the discharge of heavy flood waters. There is an extension on the left bank in the form of an earthen dam, protected in the rear by a banquette of materials not liable to scour, and on the face by broken stone up to within six feet of the permanent water level, above that with concrete pitchers. The length of crest of main weir is 324 feet, provided

with twenty-four large and a similar number of small, automatic tilting gates arranged alternately. The water is raised by this means about thirty-two feet above summer level.

Through the body of the structure are four tunnels fitted with valves actuated by screw gear, by means of which the discharge is regulated, so that a continuous supply of water is permitted to flow down the bed of the river to the offtakes of the trusts' channels.

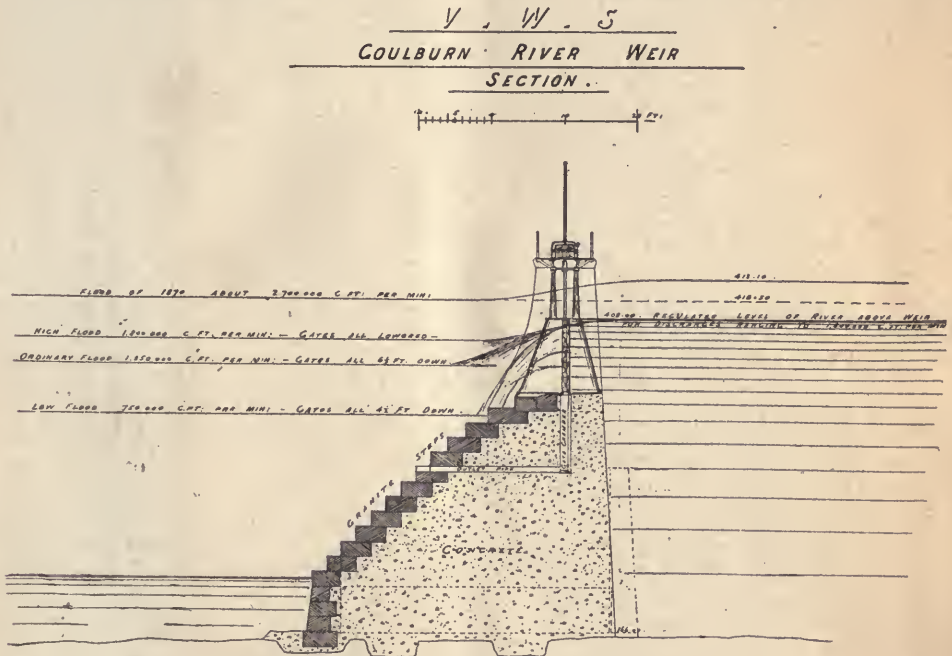
The automatic gates are of cast iron, and are based on the designs of Chaubart, a

acting in a satisfactory way. Hand gear is provided in case of the gates jamming.

The amount of water conserved is 610 million cubic feet. This with the ordinary summer flow of the river is sufficient to irrigate 40,000 acres. On this important work £133,000 (\$665,000) has been expended.

KOW SWAMP STORAGE BASIN.

A natural depression adjacent to the Murray river and supplied by the Gunbower creek, has been taken advantage of to form a storage basin from which can be



SECTION OF GOULBURN WEIR.

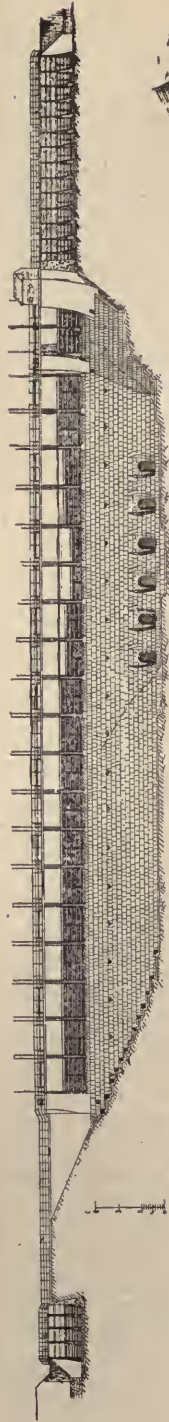
(From drawing made especially for THE IRRIGATION AGE.)

French engineer. They are set back at an angle of 90° with the vertical, are hinged about the center of pressure on a toothed sector carried on concrete pedestals, and are so balanced that when the water is flowing about a foot deep over their top edge, they tilt, thus automatically giving a very largely increased waterway for the discharge of flood waters. The small gates are arranged to open before the larger, so permitting of a gradual increase of waterway. Some trouble was experienced at first from trees, etc., carried down by the floods, fouling the gates. These difficulties appear to have been overcome, as the engineer in charge reports that they are

irrigated a large area of country. On the river Murray a timber head sluice resting on piles has been constructed. This is provided with iron regulating gates and screens, the former being manipulated by hand screw gears. When the river rises a few feet above summer level, water enters the sluice and is thence carried for a distance of seventeen miles, partly in a new channel and partly along the course of the Gunbower creek which has been straightened and otherwise made available for the purpose, to the Kow Swamp storage basin. The channel has a bed width of sixty feet, depth of eight feet and a fall of three inches per mile, and it is computed will

V. W. S.
COULBURN RIVER WEIR

ELEVATION



PLAN



AUSTRALIAN ENGINEERING.
(From drawings made especially for THE IRRIGATION AGE.)

discharge 40,000 cubic feet per minute. Breast dams and discharging weirs have been constructed where necessary along its course. Round the northern end of the swamp an earth dam five miles long has been made, partly to increase the storage capacity of the basin and partly to carry a small channel, discharging directly into the main distributing channel, on the further side of the reservoir. In case of an emergency, water can thus be led at once from the river to distributing channel without passing through the storage basin. The capacity of this channel is 10,000 cubic feet per minute, and is provided at its offtake with the necessary regulating sluices and gates.

The storage basin is capable of retaining 1,478 million cubic feet, and has an area of 6,850 acres, with an average depth of six and three-fourth feet. The outlet works consist of an open cut three-quarters of a mile long, furnished with timber sluices and regulating gates leading into the distributing channel. This has a bed width of thirty-six feet and depth of four feet and has been excavated to a gradient of three inches to the mile. Along its course are various road bridges, drainage culverts, etc. The length of this channel is about twenty-three miles to the Loddon river, under which it passes by means of a pipe syphon. Regulating and relief sluices are provided at this point. As practically the whole of the water of Loddon river is diverted above this crossing to supply various trusts, compensation water to the ex-

tent of 500 cubic feet per minute is allowed to pass into the river from the channel to supply property holders and townships below. Between the storage basin and the Loddon river a considerable area of country to the north is irrigable from this channel. After passing the river the water is discharged into the various trust channels deriving their supply from the Kow Swamp works.

LAND COMMANDED BY WORKS.

The gross irrigable area commanded by this scheme is 130,000 acres, but as at present constituted 50,000 acres can be watered in winter, and it is estimated that enough water can be stored to irrigate 25,000 acres in summer.

COST OF WORKS.

The total cost to date has been £175,000 (\$875,000) and the maintenance expenses work out at about £1,500 (\$7,500) per annum.

So far the government has charged the trusts nothing for the water supplied by these national works. It is intended, however, as the trusts become financially stronger to make such charges as will pay for maintenance, interest on the cost of construction, and provide a sinking fund to recoup the State for its expenditure.

The writer desires to express his indebtedness to the Chief Engineer of Victoria Water Supply and his officers for much information, freely given, in regard to the foregoing works.

THE PROPOSED INTERNATIONAL DAM.*

BETWEEN THE UNITED STATES AND MEXICO.

THIS matter is likely to engage the attention of Congress at the next session, and will involve entirely new questions of international law as regards priority of water rights on international streams, which will not only be of peculiar interest for their own sake, but are sure to bring up the whole question of the Federal control of interstate irrigating streams.

The history of the present case com-

mences in the year 1549, when the town of Ciudad Juarez was settled by the Spaniards on the right bank of the Rio Grande, just opposite the present town of El Paso, Texas, at which point the river crosses the southern boundary of the Territory of New Mexico, and from hence on, forms the dividing line between Texas and the Republic of Mexico.

For more than 300 years the Mexicans

* Prepared from data furnished by John S. Barnes, of El Paso, Texas.

of Ciudad Juarez have used the waters of the Rio Grande both for domestic and irrigating purposes, and so far as any law, custom or equity goes, they undoubtedly have prior rights to the use of these waters.

Now the Rio Grande rises in Colorado and flows through New Mexico before it reaches the Mexican line, and the citizens of Ciudad Juarez have for several years past complained of exceptional scarcity of water, caused by the diversion of the head waters of the river in Colorado and the numerous irrigating canals that have in recent years been taken out, both in Colorado and New Mexico.

In 1888 the river was absolutely dry for over sixty days about August and September, and in 1889 it had no flow whatever from the 5th of August to the 20th of December. In 1894 the river was dry nearly all the summer after June 15, while this year the flow stopped on June 1.

It is not seriously contended that the water rights of Mexico are guaranteed by treaties, in which only rights of navigation are referred to, neither is it claimed the recent shortage of water is entirely due to the diversion of the upper stream. It must be admitted that the seasons referred to were exceptionally dry, with little snow in the mountains, and that similar drouths occurred, and are mentioned in history, previous to any irrigation works in Colorado. Nevertheless, when it is considered that since 1881 ditches have been taken out of the Rio Grande, and its tributaries in Colorado, representing a capacity of 21,278 cubic feet per second, and that reservoirs have been constructed with a capacity of 1,729,000,000 cubic feet, it is only reasonable to conclude that this consumption of water has materially contributed to, and doubtless aggravated, the recent scarcity of water at Ciudad Juarez.

The matter has already been the subject of diplomatic negotiations between the two governments, with the result that a joint commission is now engaged in investigating all the surrounding parts and of reporting to their respective governments.

In the meantime the Mexican government has formulated a claim against this government amounting to \$22,000,000 Mexican money for loss of crops during the last ten years, due to scarcity of water, but offers to waive these claims, provided the United States government will, at its

own expense, construct an international dam for the purpose of storing the surplus waters of the Rio Grande and of giving to Mexico half the water thus obtained.

If the United States government accedes to this proposition, it undoubtedly will be a solution to the whole difficulty.

A GOOD DAM SITE.

At a point some two miles above El Paso there is an admirable site for a dam, as shown in the accompanying photographs, one end of which would rest against the granite foothills on the American side, and the other end against those on the Mexican side of the Rio Grande. The dam of stones and cement would be about sixty feet high and some 500 feet in length, creating a lake fifteen miles long and seven miles wide, with a probable storage capacity of 4,000,000,000 cubic yards of water, the surface of which will be seventy feet above the streets of El Paso and Ciudad Juarez. It will irrigate about 200,000 acres of land, or say 100,000 on the American side and 100,000 on the Mexican side, and is estimated to give a water-power of about 6,000 horsepower to each side of the river.

The cost of building the dam is estimated at \$300,000, and \$700,000 for the removal of the road beds of the Santa Fé and Southern Pacific railways, while a further sum of probably \$500,000 will be required to pay for the land which will be submerged by the reservoir. The total cost may be put down roughly at one and a half million dollars.

The 200,000 acres which could be irrigated from the proposed dam comprise some of the finest farm and fruit lands in the world, but not more than one-quarter is at present under cultivation. The valley is famous for the renowned Mission grape, of which large quantities are shipped every year.

It will be seen that the dam will not only place the citizens of Mexico in a better position than they have ever hitherto enjoyed, for it will give them both water power and an assured supply of irrigating water at all seasons, but it will also confer an incalculable benefit on the American citizens of the El Paso valley.

*Since the above was written, the capital has been subscribed in London for building a dam in the river, which will bring under ditch the 45,000 acres of land which would be submerged by the international dam. Under these circumstances this land could hardly be condemned for less than \$2,000,000.

MORE PRACTICAL IRRIGATION IN KANSAS.

BY I. N. PEPPER.



ROOKS county is one of the places in Kansas that is blessed with a fair average rainfall, the amount generally ranging from twenty to thirty inches annually, the trouble being that there is frequently no rain when it is needed the most, and possibly plenty of it when it is not wanted. In addition, there are a number of years when there is a general deficiency.

The county lies just west of the center of the State and thirty miles south of the Nebraska state line. It was organized in 1872 and now has 10,000 population, over 100 schools, and is crossed by two railroads. The climate is as good as that of any place in the country. The soil is a dark sandy loam and produces first-class crops. Grass covers the entire county where not in cultivation, affording good pasture all the year round. Hay can be had almost for the cutting, thus making it a good section for stock and dairymen. Water is pure and plentiful in streams, and springs and wells are numerous.

The first settlers as a rule were grain growers, breaking up the native sod and cultivating about 200,000 acres of this vast meadow. With thirty inches of rainfall the crops were good, but with only twenty inches they were failures and those who had no cattle left the county. After several more attempts at dry farming, those that remained began to cast about for some method of supplying the small amount of moisture lacking, and of saving the surplus rainfall which they did get occasionally.

Many plans and suggestions were offered, but the only practical solution was irrigation supplemented by subsoiling. Investigations have demonstrated that there is a sufficiency of water if it is conserved and utilized. Wells are being bored, wind mills and pumps erected, water courses dammed, streams diverted by ditches and every means to impound the water and hold it for a time of need, resorted to.

The results have been gratifying in the extreme, and doubts concerning the arti-

ficial application of water removed from the minds of the most skeptical. Their only question now is, "How can we irrigate?"

There are two irrigation canals in Rooks county, owned respectively by the Bow Creek Irrigation Company and the Stockton Irrigation & Power Company. The Bow creek ditch was the first to be built. It is seven and one-half miles long, has a capacity of thirty-five second feet of water and covers about 1,000 acres of land. The Stockton ditch is three miles long, with a capacity of 100 second feet, and waters about 800 acres. It can be considerably extended.

In addition to the two enterprises mentioned above, there are a number of small individual irrigation plants.

Last year was the first in active operation of the Bow creek system, and the crop yields were astonishing.

Fifty acres of potatoes produced 10,000 bushels; onions yielded 600 bushels per acre of fine quality; cabbage four to six tons per acre; turnips 100 bushels on eight square rods, or at the rate of 2,000 bushels an acre. For oats, the land was irrigated in November, 1894, and seed sown in March, 1895; the yield was sixty-five bushels per acre, weighing forty pounds per bushel. In the same field and under the same conditions, except the irrigation, the oats yielded seven bushels an acre; corn, irrigated once, forty to fifty bushels an acre; the corn not irrigated was a failure.

On four acres under the Bow creek ditch, F. Near raised 1,100 bushels of best grade potatoes, with an actual expenditure of only \$7.00 for labor up to the time of digging.

An accident was the means of benefiting A. Jones. On July 19, 1894, the water broke through the bank of the ditch and flooded an acre of corn. On July 26 there was a hot wind, but it in no way affected or injured the acre that was accidentally flooded.

J. K. Wendover raised good corn with one watering, and first-class potatoes.

Cooper Bros., under the Stockton ditch,

are now cutting alfalfa seeded last June, and it is an extra fine and heavy yield.

The pumping plant of F. Shults irrigates twenty-two acres. His onions yielded 600 bushels an acre.

P. J. Griebel irrigates five acres, has a good garden and raises fine fruit.

Chas. Marten has five acres in a bearing orchard, mostly apples, irrigated by a pump.

Many farmers raise crops worth from \$50 to \$100 on an acre of irrigated land, and I know of some who have produced \$800 worth of cabbage on one acre.



FIFTY ACRE CABBAGE FIELD UNDER THE IRRIGATION DITCHES OF THE BOW CREEK SYSTEM.

THE ART OF IRRIGATION.

CHAPTER XIV. THE GREAT FLOODING SYSTEM OF THE SAN JOAQUIN VALLEY—Continued.

BY T. S. VAN DYKE.

THE large checks described in the last chapter are almost always fed from the side and not from one end. They are generally so long that if fed from one end the water would have too long a run to reach the other end. It would also have less room in which to spread, and the large head needed to cover so much ground below would cut the soil too much, unless it could spread out. In case you want to cut the check in more than one place to get the water quickly out of it, which you generally should do, you cannot empty it so well from the end as from the side.

When made with the plow, as described, there will be a low swale adjoining the bank which will hold water too long, unless the bank is cut all the way down. Some things at some times of the year will not be injured by this. Old alfalfa, in winter, seems to suffer little if any in this way. But young alfalfa or grain would be damaged at once by it. Most

fruit trees would not be hurt by it in winter, whereas it would be ruin to some, and damage to the fruit on most anything but pears to have them in such a swale in the summer or spring. And when the sun is hot, old alfalfa and grain old enough to cut for hay would quickly show a material loss.

On the reclaimed swamp land mentioned in the last chapter all the irrigation of alfalfa and grain is in the winter, and even that of corn is practically so, it being irrigated not more than twice and often only once after coming up. Remember the average rainfall here is about four inches, or practically nothing in assisting the summer growth. But this soil is a mixture of tule roots, rushes and reeds for many feet deep, with water at an average of about eight feet, and rarely over ten feet below, the year round. The capillary attraction of this soil is enough to draw water more than half way to the top. It is very re-



VIEW OF AMERICAN SIDE OF THE SITE OF THE PROPOSED INTERNATIONAL DAM.



VIEW OF MEXICAN SIDE SHOWING RAILROAD TRACKS THAT WILL BE REMOVED.



THE GOULBURN WEIR, VICTORIA, AUSTRALIA.



THE LAANECORIE WEIR, VICTORIA, AUSTRALIA.



WASTE WEIR AT HEADGATE OF BOW CREEK IRRIGATION SYSTEM, ROCKS CO., KAN.

tentive of moisture, so that if wet thoroughly in winter it will, by the aid of the rising moisture from the bottom, hold water enough in the top to mature such crops as grain that ripen very early in the spring, and it will come very near ripening even corn that runs far into the summer. Alfalfa, whose roots quickly go down to this permanent moisture, only needs a good stimulus of water in the top soil to start it more quickly, after the cold nights of midwinter have checked its growth.

GRAIN.

On this ground grain is sown *dry*. It is then plowed in, or rather scratched in, for there is no apparent advantage in deep plowing on this particular soil, as it is all loose enough except the crust, which will be formed on any fertile soil by excess of water. It is then irrigated so as to fill the top soil with enough water to sprout and carry it until ripe, in connection with the winter rains, of which there are always some of value, even in the driest times; one-third of an acre foot of water put in the ground will do this, for there is no loss of moisture downward, the entire subsoil being saturated instead of dry. If you will note how quickly a piece of dry, unplowed ground saps the moisture for several feet from a freshly irrigated piece beside it, you will understand how, with a dry subsoil, more moisture (not water only) will be lost downward than is lost upward by evaporation. But if there is no loss of this kind, grain well started with the top soil filled with water matures before the summer heat has its effect in drying out the top soil. Very heavy crops are raised in this way on this ground.

On the upland, where it is many feet to water, and where the subsoil for yards is as dry as the top soil, unless soaked from the ditches, all flooding is postponed until the grain is so large that it cannot be easily injured. The different quality of the soil is the principal cause of this. It is a fine granite wash, containing enough fine material to make a tough paste without enough humus to prevent its formation. On the swamp land there is so much vegetable matter mixed with the fine granite flour that it cannot make as hard a paste. To flood this upland after the grain is planted and before it has started would be to kill half or more of it at once. Dependence is therefore placed on the slow, gentle

rains, which do not beat down and puddle the ground. If the ground were thoroughly irrigated before plowing it would retain moisture enough to insure the starting of the crop in fine shape, but for grain at present prices this is considered too expensive, even when the farmer does his own work with his own teams. He would rather put in a larger area and gamble on a good rainfall, and from his standpoint of large farming it is hard to say he is not right. Therefore he plows his ground dry—that is, without irrigating. It may or may not be moist from the first rain, and generally is as dry as powder when plowed. Then it is checked for future irrigation if there are no permanent checks on the tract. Many of these checks are temporary only, especially where one is working rented land, as many do. Then the seed is sown for the rains to sprout and carry up to the point where it will stand flooding. This flooding is postponed as long as there is no danger of the crop suffering, and often it receives no water until headed out and even in the milk, while it is rarely irrigated until in the boot, unless in winters very short of rain. A second irrigation is rarely needed, but can be given if required. The water is applied sparingly and not left on the ground, even as long as for alfalfa. Even when quite old, grain of all kinds will quickly scald if the sun is hot, and great care must be used. While a delicate operation, large crops can be raised by irrigation with certainty and success, and tens of thousands of acres are thus raised here every year. Corn, and all summer crops like Egyptian corn and similar things, are raised in large quantities under the same system, though the yield to the acre is not what it would be if less water and more plow were used. But there is certainly a limit on fine work, and where land and water are so plenty and cheap it no doubt pays to work a larger area with a lower yield.

None of the land of Lux & Miller is yet for sale, but that of the Kern County Land Company is for sale for much less than any one person or ordinary aggregation of persons could ever put on the water from any source—from forty to sixty dollars an acre for as good land as the sun shines upon, with an annual payment of a dollar and a half a year on the greater part, running, under some of the canals, to two and a half. The water right is a cubic foot a

second to 160 acres, or about an inch to three acres, or nearly five acre feet. Several thousand acres have been sold and settled, and the work of the settlers is very instructive as showing what human nature will do when it has a good chance. They have almost to a man selected good land. There their wisdom generally stops. There are a few places from which a stranger might find something to imitate, but they are rare.

TOO MUCH WATER.

The Land Company, desiring to accommodate all its customers, and having all the time an excess of water, has put no restrictions upon consumers. The allowance of a cubic foot to a quarter section is already too great for anything but alfalfa, and not really needed even for that, but the rule has been to let all have all they want and in heads of any size they want. The result of this mistaken kindness can be seen all over, in damaged orchards, and in the few places where there is any hard pan or stratum of fine material underlying top soil, alkali is on the top soil to a ruinous extent. Soil and climate, and all conditions, show that as fine fruit can be grown here as in any part of California, which means in the world. Many places where some care has been used prove that it is so, the yield and quality both being beyond criticism. But many more show suffering trees that cannot bear good fruit, and that before long will bear little or nothing, and all because they have plenty of water. Every one floods for everything. Where the soil will carry small streams, and where they would be cheaper, more healthful, and in every way better, you see none of them and no attempt to do anything but flood. Imitating the work of the great farms, they make the checks too deep, put more water in them than is needed and keep it there too long.

The only cultivation is scratching the head to see how work with the plow and cultivator can be dodged. The effort has been very successful. I hate to say there is not a well cultivated orchard in the county. Therefore I will not say so, but that is my only reason. Even the flowers around the house are planted in checks of all shapes and sizes that are never broken, the ground being as hard as the floor of a brick yard. There are some orange trees near Bakersfield that are good enough to

show that a fine orange could be grown there. But no one seems to know that they are treated in the exact method in vogue twenty years before, two hundred miles south of them, and that never failed to produce a dry, insipid, sour, spongy, thick-skinned orange—to wit, incessant flooding with no cultivation. A gentleman who has been there over twenty years, told me that scores of men had bankrupted themselves and had to leave in three years, by the excessive use of water. Some do it because they think they are getting ahead of the company, although it is by its favor that they are able to do so. Others do it because they imitate these others. Some do it because they think water cheaper than work, a principle that is sometimes a very good slave but always a very bad master. Still others do it because they think turning on water is all there is of farming by irrigation. Some do it because they don't think at all, and some because, having the water turned on, it is too much like work to go to the gate to shut it off, California being full of people who came here to play and not to work.

But wherever the water has been used with any care you may see prosperity at once, in spite of the want of cultivation. Cultivation would make it still better but even without it it is plain that flooding pays. Good orchards and fine alfalfa patches may be seen in all directions, plenty enough to prove that intelligent handling of the water is all that is needed to make this the largest garden of California. The misuse of the water has proved that not more than one hundredth of one per cent of the land can be alkalied and the way the alfalfa stand, the incessant tramping of the big bands of cattle, especially on the large ranches where they are never taken off of it, shows a vitality and toughness that in many other places it does not have.

FARTHER NORTH IN THE VALLEY.

Going farther north on the San Joaquin we soon reach the fertile fields of Tulare county. Here, even on the larger farms, we find the checks like those of the smaller places in Kern county, very much smaller and more shallow than those of the immense places above described. Most of them are square or rectangular, though many of them are conformed some-

what to the contour of the land. But there has been no such systematic laying out of the land as I have described. Many of the checks are not over five acres, running up to twenty and even forty acres, while on the ten and five acre tracts they run down to a quarter of an acre or even half of that. Most of them are made with the plow and scraper and on some quite level ground they are apparently made with the plow alone. Fifteen and eighteen inches are about the maximum heights, with many not over a foot. All are made broad at the bottom and almost all are permanent and can be driven over with machinery of any kind.

Gates from one check to another are here very rare and the main reliance is on cutting the check. But in many cases they do not feed one another and the checks are arranged in lines along laterals. In many cases the only waste ditches are natural depressions which retain much of the water to the joy of the mosquito. The average depth of water in the checks is less than is too often used in Kern county, and seldom exceeds six inches. The land here is extremely rich for many leagues and prosperous farms of alfalfa and general crops, with fruit farms of all deciduous fruits are about one. The never-failing and beautiful Kaweah pours every year, across the land, a bountiful supply of water and what was once a vast park of immense oaks is now in long lines of farms, with only a little park of the ancient oaks about the house or out in the pasture, to shade the thousands of cattle from the heat of a summer's noon. It is a lovely land to look upon, but here too the fatal gift of plenty of water has wrought ruin on many an acre of the deep rich mould of the old park and undone many a two-legged hog who thought he was getting ahead of his neighbors or cheating the water company.

ALKALI.

Thousands of acres are now useless from alkali on the surface, where it is evident from the surroundings and the character of the subsoil in adjoining cuts that there was no excuse for it. Most all of it can be reclaimed for there is plenty of drainage, but even such temporary ruin is shameful. It is but a few feet to good sheet water under the greater part of the land, with no hard pan of consequence be-

low the top soil. There is only a sheet of finer material over the greater part of it two or three feet below the top. With water so near the surface and the rainfall much greater than in Kern county there is no need of using any more water than is used south of the Tehachipi mountains where the finest work of the world is done.

On the greater part, furrows could be used as well as elsewhere, and the water now in the ditches could do twice or thrice the work it now performs. Yet everywhere you see where fields have been turned into swamps by allowing the water to run long after it should have been shut off, orchards with the top soil condensed to a cement by too deep, as well as too long standing water, others where the waste has been allowed to stand in the last checks because there was no waste ditch or because it was clogged up and the owner was too lazy to clean it, still others where the soil looks as if it was wet every week and never had a chance to dry. As I remarked about the other place, I don't like to say there is no attempt at good cultivation, therefore I won't.

But in spite of all this there are so many places that show unmistakable success in making, not only a living but also some money that, in spite of the gross waste of grand opportunities this settlement must be considered a great triumph of irrigation. There is no place in the lands depending on the rainfall direct that can show any such wealth to so few acres and certainly none that can show so many farmers out of debt and with a comfortable balance in bank. There are unmistakable signs of prosperity, in spite of the hard times, that he who runs may read, and nowhere are they more positively written all over a section than over a great majority of the alfalfa fields and orchards here. On the alfalfa farms and especially those mixed with a little fruit and vegetables, with corn and pumpkins, Egyptian corn and some other things, you can see at a glance that certain living that once made the American farmer the most independent of mortals, as he was then called, and the neglect of which has reduced too many to the most dependent. In the fat cattle and the baled hay, in the corn in the bin, in the hens cackling around the straw stack, and the turkeys strutting about the road, you see a surplus for pin money, while the big udders on the cows and the great

numbers of fat hogs in the fields show that they do not live on Chicago canned beef or flavor their coffee from tin cows. It is the farming that the American farmer must drift back to. He must quit listening to those who tell him that any system of finance or any abundance of money will enable him to buy everything he can raise himself, hire work that he can do himself, and enjoy, simply because he is an American farmer of the nineteenth century, luxuries that the richest dirt never yet has justified in any other country. The irrigating farmer can restore farming to its ancient respectability and he is probably the only one that can. It must be so restored, or there is little increase of prosperity in store for the great United States. The farm must be made attractive to the boys, and the irrigated farm now comes too, near being the only one where they can see that they are not working for nothing. On the irrigated farm the girls, too, can see something beside work ahead, and the old folks feel while pulling the sled uphill that there is a chance for them to ride down before they die.

Following the winding Kaweah up the foothills and into the great canyon, down which it foams from the lofty Sierra Nevada, I found many places where every variety of irrigation was attempted. Tulare county too has its "orange belt," and its a hard county in California that has not. This belt, though not over large, is unmistakably good but suffering from bad irrigation which the orange is sure to do. The looks of the trees told the tale well enough. Many of the oranges and some of the lemons were indicating foot rot on ground that was naturally well drained, an almost unfailing sign of over-irrigation. One man was making a vigorous attempt to irrigate with small furrows. The soil was plainly fine enough in texture to enable him to do it, but the ground was sloping about twenty-seven different ways in wavy lines, and the water had evidently become so tired trying to get somewhere that it had finally given up the job and settled down permanently in the middle. By the time he finds he wants the ground graded to an even slope on every face on which the water is to run, the orchard will be too old to change and then the swearing period will fairly begin.

I found some people irrigating by planting along the ditch in the old Indian way

and others letting the water wallow around over the ground to suit itself and planting on the dry bumps it had left, but nowhere a decently irrigated place, although there was abundance of fine soil and an over-abundance of the finest water. But the place at which I spent the night, well up in the canyon, skimmed the cream of the whole entertainment. The owner was a rich old settler with money out at interest in all directions. He had a ditch carrying about four feet of water, or two hundred inches. This ran through his store making, at one side of the door, a drop of some five feet upon an overshot wheel which turned a large fanning wheel in the center near the ceiling. In the breeze of this, the old gentlemen sat and drank beer and smoked away the summer days while waiting for customers. Passing on some hundred yards or so, the water spread upon a gravelly flat of five or six acres. This was filled with alfalfa and fruit trees. There were peaches, prunes, pears, apples, silver prunes and nectarines all ripe, and we were badly in need of fruit, especially on the return from a fishing trip near Mt. Whitney where it is a little cool for fruit. The alfalfa and fruit trees were all in a huddle together and the evident design was to get both irrigated at one stroke to economize labor. The labor of shutting off the water was evidently objectionable and therefore never done as far as appearances went. The whole of this enormous head was running upon this five or six acres all the time we were there, and coming and going, and there was good reason to believe it had been running all the season. There was a fair stand of alfalfa on it in spite of the cows nibbling, but the fruit was everywhere sour, insipid, and *small*. It was about the worst I have seen in California and that is saying a good deal, for while California can raise the best fruit in the world with good care, it never makes a failure of raising the most abominable on earth when it tries.

Now the point I wish to emphasize is this—this was a wash of coarse gravel standing on a slope so great that in spite of the great head of water it all drained away underneath, the top showing no sign of swampiness anywhere. Here, then, was the choicest of conditions for growing the best fruit on earth, climate and all being as perfect as the drainage. The alfalfa

did quite well because it will always do well on well drained soils, even if pretty poor, for to some extent the theory that it makes its own fertilizer seems true. But the food the trees demanded was leached away by the constant run of water, making trees and fruit both small although the trees were lightly loaded; while the trees, sickened by having the roots all the time too wet in spite of the drainage, could not produce good fruit even on rich soil.

As I remarked in the beginning of this work, bad irrigation is generally far ahead of no irrigation, even in those countries where so much can be raised on the rainfall as to make people feel insulted when you advise them to irrigate. Yet nothing

is more foolish than to follow the methods of certain sections simply because they are succeeding. You may learn much in the San Joaquin valley about flooding especially on the large scale. But when you have seen it all, spend a few days among the small farmers of Orange county if you want to learn how to make a good living and some money over, out of a small piece of land with, the smallest amount of discomfort, and do, it all by flooding. Yet there you can learn nothing much about furrow work for their land is generally too open for it and they should not attempt it. To see that, go to San Bernardino and Riverside counties, and the east half of Los Angeles county.

IRRIGATION AND SUBSOILING. PRACTICAL METHODS IN VOGUE IN MONTANA.

By S. M. EMERY, of BOZEMAN.*

THE conservation of moisture in the semi-arid States, is quite as important a problem as is that of securing the benefits of irrigation in States where this has not yet been practiced.

In the Gallatin valley, the acknowledged peer of all agricultural development in Montana, if not, indeed, of all sections of the mountain States, land is cheap and abundant, and the practice of summer fallowing is quite universally practiced.

There are large areas of bench lands above the water course level, on which crops are grown uniformly successfully by summer fallowing each alternate season, winter grains being the common crop. In the valley proper it is the general custom to summer fallow every third year, alternating the two seasons to oats and barley, or wheat and barley, and occasionally to wheat and oats.

By this practice they are able to uniformly grow crops double and treble those in States where water is not used.

There are well-grounded objections to this style of farming, especially where irrigation can be practiced. It is an expensive way to farm; the land usually becomes weed-sown, and scientists teach that it is injurious to soil to turn it up to the summer storms and sunshine unprotected by verdure, and taxes and, too often, interest are being assessed, whether the land

is producing or not. By personal inquiry it was learned that the average of fallowed land in the Gallatin valley in 1895 was more than 100 acres per farm. This affects quite seriously the question of additional water, when the time comes, as it most certainly will, for yearly cropping of all Montana farm lands. Had the entire area of land under plow in this valley been sown to grain crops in 1895, there would have been many crops injured from lack of sufficient moisture.

DIVERSIFIED CROPS.

The Experiment Station Farm is being cropped, every foot of it, each year, and though there is a water right of 100 miners' inches to 185 acres, it is ample for the farm requirements. Crops are diversified—alfalfa, clover, field peas, potatoes, mangels, carrots are favored crops. In grains wheat, oats, barley, flax and rye are leaders. By thus diversifying, the use of water may be protracted at each end of the grain irrigating season, the grasses and clovers being watered weeks ahead of the grain crops; again, fall irrigation has been practiced with the intent to store moisture against the day of need.

The writer has been strongly impressed with the importance of deep culture, and is now reaping a mis-benefit therefrom in a phenomenal crop of wild sunflowers on

*Director of the Experiment Station.

lands which for two years past have not ripened a sunflower seed. Evidently the seed have lain dormant in the soil for four or more years, deeply buried by an extra deep plowing in the fall of '93 and resurrected the presentspring by a similar course.

Deep plowing, as ordinarily practiced, is not satisfactory where there is heavy clay subsoil; too much subsoil is exposed on the surface. This is doubly bad where water is applied to grain crops as the clay will dissolve, puddle the surface of the ground and bake so hard that a second irrigation brings little relief to the crops.

BENEFITS OF SUBSOILING.

In 1895, ten acres in which potatoes were to be planted were subsoiled to a depth of eleven inches. The single subsoil plow was used, drawn by three horses, and following a turning plow also drawn by three horses. Considering that two men and six horses were employed, and that one and a half acres per day was a daily average, it was expensive work. In irrigating it was found that much more water was required to submerge the soil than on lands not *subsoiled*. This piece of land is now sown to barley, and gives promise of being an extraordinary crop. (The tract has never been manured to the best of our information.) Upon receiving a prospectus of the Secretary plow, made by the John Deere Company, one was ordered and has been used upon fifteen acres of spring plowing.

This plow is a combination of the disk and subsoil plow, and, by a single operation, the ground is subsoiled each two inches in ten, and the top soil completely pulverized by the action of the disk plow. Its strongest point is that the wedge principle involved in all turning plows is applied only to the two-inch strip under the subsoiler, the disk working above the subsoiler, and cutting and partially turning ten inches, while the subsoiler works two inches in width.

The application of water to the soil thus treated this spring will be watched with the keenest interest and it is a foregone conclusion that it will absorb at least double the amount of water that soil fitted with the old-style turn plow does. To get the full effects of such moisture deposition, it should be coupled with a high state of preparation of soil prior to seeding, so complete as to pulverize all clods and lumps; subsequent to seeding,

the ground should be rolled to compact the surface and hasten germination, and prior to the appearance of the young blades of grain the ground should be gone over with a fine tooth harrow each way, so as to supply a dust blanket to prevent undue evaporation of moisture.

It is of the utmost importance that water be used at the earliest possible moment after grain is well up. There is then an abundance of water and, unless storage reservoir facilities are provided, the farmer must daily see water run to waste, the use of which in a very brief time would mean a difference between failure and success.

Upon this same subsoiled land, well-rotted barnyard manure is now being applied upon growing grain crops with the Kemp & Burpee manure spreader. This gives an even distribution of manure, no lumps being thrown out, all such being well pulverized by the revolving cylinder, armed with sharp pointed teeth which tear all lumps to pieces.

This spreader was used in 1895, until the grain began to joint, and though it seemed as if the battered and bruised grain would never recover from the severe treatment inflicted in driving the wagon over the fields; yet, in three days time after the application of the water, one could not tell where the spreader had gone, save by the deep rich color and the rank growth of the grain.

Subsoiling, thorough preparation of the soil before and after seeding, a diversity of crops, the use of clovers and root crops, and top dressing of grain fields must all be practiced by him who expects to make the most of a limited water supply.

To one unaccustomed to the use of water it may seem paradoxical to urge a course that will require more water to saturate the soil. It is, however, true "the more haste the less speed" in this case. One should endeavor to make a crop with one irrigation, as it is exceedingly difficult to make up to crops by a second irrigation that which they have failed to receive in the first use of water. In mountain regions the second or third irrigation has a tendency to unduly prolong the growth of grain and to expose it to the ill effects of early frosts. Hence the important part played by deep culture in the conservation of moisture.

WATER SUPPLIES FOR IRRIGATION.

CHAPTER VI. STORAGE RESERVOIRS, EVAPORATION AND PERCOLATION.

BY F. C. FINKLE, C. E.



UCH surveys and examinations as will give a complete description of the character and condition of the watershed should be made. The points to be noted are the slope and pitch of the surface at different places, the character of the surface

formation, the range of elevations and the amount and class of vegetation. All observations of this character furnish data from which the value and capacity of a watershed can be estimated.

The ability of a watershed to furnish water for storage depends upon the matters which we have already discussed, *i. e.*, the area and character of the watershed and the amount of annual precipitation thereon. The old school of hydraulic engineers were wont to assume that the discharge of water from a watershed, available for storage, was equal to one-half of the total annual rainfall on the watershed. While it is true that this was the general assumption, still there were many who depended more on their own judgment as applied to each individual case. This latter method is not entirely unsatisfactory as the judgment of one well versed in hydrology, when he is acquainted with the geological structure, extent and physical characteristics of a watershed, is usually able to grasp its capacity for yielding an available water supply, by deciding what proportion of the rainfall will be discharged and what proportion will be lost in various ways. But neither of these methods are satisfactory for making close and accurate estimates, and since statistics have been collected from observations made and recorded by government bureaus and hydraulic engineers, the matter has been reduced to more of a science.

The observations from all points do not

exactly correspond, which makes it difficult to produce a formula which will give results for all places. It appears that results obtained from localities where the distribution of the rainfall is uniform throughout the year, are somewhat different from those obtained in regions where the year is divided into a rainy and a rainless season.

Our investigations being in the interests of irrigation, we will devote ourselves to constructing a formula applicable to regions with the year divided into a wet and a dry season.

FORMULA FOR STORAGE SUPPLY.

By plotting such results as have been collected from observations made in irrigated localities or localities requiring irrigation, where the distribution of the annual rainfall is somewhat irregular, the resultant has been found to follow very closely the following formula:

$Q = A \frac{f}{c} \times pcf$, in which

Q = the number of cubic feet of water discharged during the year.

A = area of watershed in square feet.

p = percentage due to character of watershed.

c = a variable factor depending on the annual depth of rainfall.

f = the depth of annual rainfall in feet.

The percentage due to natural characteristics of the watershed and represented in the formula by the factor p varies from .30 to .85.

The mean values are as follows, and for cases not corresponding exactly to the descriptions given, values intermediate to those given can be assigned in actual practice:

For steep, rocky hills and mountains from .75 to .85.

For heavily timbered hills or mountains and moist brushy and swampy lands from .65 to .75.

For rolling grassy brush or timber land from .50 to .65.

For tolerably flat or gently sloping alluvial plains, with little grass and brush from .40 to .50.

For flat or gently sloping cultivated lands from .30 to .40.

The variable factor c has the following values:

For an annual rainfall of 40 inches or upwards, $\frac{3}{4}$; for 30 inches, $\frac{2}{3}$; for 20 inches, $\frac{1}{2}$; for 10 inches, $\frac{1}{3}$; for less than 10 inches, $\frac{1}{4}$.

The values of c intermediate to those given can be found by simple proportion, and all values when used in the formula should be written in per cent decimals, which are better adapted to logarithmic computation.

From the recorded observations and the formula deduced therefrom, it is patent that a large portion of the water falling from the clouds does not flow off on the surface of the ground. This water becomes lost in various ways, or in other words goes where it is not visible in channels on the surface, nor can it be collected to fill storage reservoirs. A portion of it is evaporated, and returns to the air to again fall as rain; a portion is consumed by the growth of vegetation, and the remainder, which is by far the greatest portion, sinks into the ground and goes to constitute underflow of streams, subsoil water, spring water, and the water contained in artesian strata.

When it is possible to do so it is always advisable to measure the daily discharge of water from a watershed, in addition to making a survey of it and gaugings of the rainfall. By doing this it is possible to determine accurately what is the actual quantity of water running off on the surface without the inaccuracies and uncertainties which are always involved in theoretical formula and calculations. Usually the cost of measuring discharges from streams is quite great in comparison with the cost of gauging the rainfall, and for this reason it can not be carried on so easily nor for any great length of time, unless in exceptional cases. In all cases, where it is possible to do so, the discharge should be measured and the rainfall gauged as well for at least one year. In this way the variable factors in the formula can be given fixed values applicable to the watershed in question, and the formula

can be so expressed as to eliminate all elements of uncertainty, so that perfect results for the watershed in question can be obtained for subsequent years, although observations of the rainfall alone are made.

EVAPORATION AND PERCOLATION IN STORAGE RESERVOIRS.

All the water accumulated in storage reservoirs can not be applied to useful purposes. There are certain losses causing shrinkage in the volume of water after it is impounded, which must be deducted before the amount available for use can be ascertained. The two principal means by which water is abstracted from a storage reservoir are evaporation and percolation. The former of these can, in ordinary cases within the region where irrigation is practiced, be considered to equal the amount of rainfall on the surface of the reservoir. At all events it is perfectly safe to make this assumption, as the rainfall on the surface of the reservoir is more likely to exceed the evaporation than not to equal it. Of course, when evaporation is accounted for in this way, the area of the impounding basin must be subtracted from the total tributary watershed above the dam site, in making the surveys and estimates of available watershed for filling the reservoir.

The amount of percolation is a more difficult matter to arrive at, as the soil comprising the basins of storage reservoirs may be of any conceivable nature. Very often ledges or veins in the sides of the basin may convey a considerable amount of the water impounded away to points below the dam. In cases of this kind, where the loss of water is great, it can readily be noticed and remedied. If the water entering the reservoir is heavily charged with silt and sediment, the difficulty may remedy itself. The most dangerous species of percolation, however, is that which finds its way into entirely underground channels and can not be noticed except for its effect in diminishing the water in the reservoir, as its reappearance takes place so far away that it can not be easily detected in this way. The only way of determining its amount is by accurately measuring the water drawn from the reservoir, while observing the exact quantity disappearing from the reservoir during the same time, as well as the quantity entering it if any.

In faultily constructed dams there is sometimes a loss by percolation through the dam, but in works properly planned and carried out, the loss on this account, if any at all, should be so small as to be of no practical consequence.

SUMMARY OF NECESSARY SURVEYS.

Considerable reference has already been made to surveys necessary in the investigations relating to storage reservoirs. A summary or recapitulation on this point may not be amiss, as the subject is one of great importance. The following are the principal details, which should in all cases be covered by such surveys: The area of the reservoir site or storage basin should be traversed with a line containing no greater error in closing than is usually admitted in making surveys of land boundaries.

Contour lines should be run throughout the reservoir site at elevations of not more than ten feet apart.

The area of the watershed should be determined by a survey such as the necessities of the case may require. As has already been stated, the location of the principal points on the boundaries of the watershed is sometimes sufficient, while at other times the exigencies of the case may require a traverse survey similar to that recommended for obtaining the area of the reservoir site. The topography of the watershed and the length and courses of its main drainage channels should be de-

termined by appropriate surveys. Cross-sections of the canyon or outlet of the valley at the point selected for the dam site at distances of not more than ten feet apart, for a width of not less than an eighth of a mile.

Borings to bedrock, or other material, suitable for a dam foundation, should be made across the canyon at the dam site at intervals of about twenty-five feet.

Surveys should be made to determine in what manner the water can be drained from the foundation of the dam. If the draining can be done by cuts or tunnels the length of these should be measured, and the material through which they will be constructed should be noted. If the draining must be by means of pumps, the height to which the water will be pumped, as well as the quantity of water to be raised, should be determined.

The gauging of the rainfall and discharges from the watershed already referred to should, of course, be made with great care, and such other observations in regard to evaporation, percolation, etc., as are deemed of value should also be made.

When all of these data have been collected by reliable surveys, the calculations necessary to determine the value of a reservoir site and the cost of improving it become an easy matter, and an engineer can proceed to make his report with certainty and confidence.

ADULTERATION OF FOOD PRODUCTS.

BY W. C. FITZSIMMONS.

THE average citizen has little conception of the extent to which much of our daily food is adulterated with foreign substances, many of which are injurious to health. A still greater portion of the adulterants used are often, if not always, distasteful or disgusting. A theory of some scientists is that the ultimate atoms of matter are all of the same substance, and that material things as we find them, so varied and diverse in characteristics, are merely the results of an infinite diversity of combinations among the ultimate atoms and molecules of matter. It is asserted that a palatable article of syrup may be

made of rags; and while the ultimate analysis of the two might reveal the same primal elements in their composition, the knowledge of the fact would scarcely render such syrup especially appetizing.

In order to give readers some conception of the extent to which adulteration of substances daily consumed by all is practiced, citations from a report emanating from the Department of Agriculture will prove of value. It was found by a series of careful and prolonged investigations covering the range of nearly all food products, including potatoes, that the amount of adulteration is at least 15 per cent. of which no less

than 2 per cent. is of a character injurious to health. In this report the cost of food, drink and drugs annually used by the people of the United States was placed at \$6,760,000,000, and that we pay for the frauds and cheats used in our annual food supplies \$1,014,000,000. But this is not the the worst of it. For the substances used which are clearly injurious to health, we pay the enormous sum of \$136,200,000. The lives of many and the health of millions are thus sacrificed and impaired at enormous cost without any compensating considerations whatever, except that of putting blood money into the tills of ignorant or unscrupulous dealers. In view of the enormous extent to which food adulteration is now known to be carried on throughout the country, the people cannot too soon awaken to the dangers that beset them on every hand. Whatever stringent legislation may do to check this growing evil should be done without delay, and such precautions taken by the strong arm of authority as will protect the average consumer from the criminal rapacity of those who thrive by the nefarious business of adulterating food products.

In this connection, Special Agent Wedderburn of the Department investigation says: "As there exists no more serious or exhaustive drain upon the resources of the people than the adulteration of their food and drug products, the federal government should enact a law to prevent the transportation of misbranded, poisonous or deleterious food and drugs from one State or Territory into another, not interfering with the police powers of the State."

No doubt such a law, strictly enforced, would tend greatly to lessen the consumption of adulterated food. Yet it must be remembered that there are great numbers of people who daily consume food known to be adulterated by substances which should be and probably are known to them to be deleterious. Such people must be protected against themselves by prohibiting, so far as is possible, the manufacture and sale of foods produced from unsuitable materials, as well as those adulterated with needless or unsavory substances.

Professor Berthelot, the renowned French chemist, believes that ultimately, nearly all human foods will be made artificially from materials drawn from the air and the earth. These will be synthetically combined in great factories and will re-

sult in pure foods, containing the proper proportions of each of the chemical ingredients of which we now find them composed. There is nothing revolting in this idea of the great chemist, for it is inspiring rather than otherwise the thought that the time may come when we shall derive our food supplies from first hand, and without the necessity of their having passed through the filthy workshop of nature as we see it. While we may consume something of the contents of the city sewers in the potatoes or oranges used on our breakfast tables, we have no desire to dwell upon the too intimate relations between cause and effect in this connection, or to scrutinize too carefully the natural processes by which the ultimate combination was reached. We must merely accept the general fact that the molecule of nitrogen which found its way from the sewer to the pulp of the orange, reaches us practically uncontaminated.

But while we are waiting for a realization of the iridescent dream of Berthelot, we may properly give attention to some of the practices of our fellow citizens who are less scrupulous about the sources whence they draw the material for the so-called food products which they place upon the markets. It will be remembered that Senator Manderson, of Nebraska, was recently reported to have made a stout defence of the manufacture of what is vulgarly called "bull butter." * He is reported to have affirmed that his senatorial appetite was more appreciative of the value and toothsomeness of oleomargarine than of the average dairy butter of Nebraska. Whether the report was a libel against the Senator, being incorrect, or whether, being correct, it was a gross libel against the dairymen and farmers of Nebraska, it is not material here to inquire. The main thing is that one of the honored lawmakers of a great State was reported to favor the substitution of a product, which may be and often is made from highly unsavory materials, for the genuine article of butter properly made in a cleanly manner from healthy sources.

Those who agree with Senator Manderson that oleomargarine is as good as genuine butter, may possibly modify their views on reading the following from one of the recent monthly magazines:

"Not the least interesting feature in New York is the value of the dead horse that

one sees daily fallen by the way in our gutters and on our pavements. What it ultimately will produce in commerce is between \$25 and \$30. There is not a part of the animal that has not mercantile uses. Out of the hide are wrought gloves, boots and shoes; the hair goes into cloths and mattresses; the bones into buttons; the flesh into oil fat, oleomargarine and butterine; the hoofs into glue; the intestines into delicate membranous pouches for drugs and medicines. And it can scarcely be an agreeable sensation to those of the Ameri-

can body politic who swear their gastronomical faith on a plate of buckwheat cakes ordered from the restaurant of the period, with a side partner of three strata of butterine alongside for concurrent consumption, should he stop to reflect that the fleshy part of a dead horse, seen perhaps a week previous lying on Broadway, was the basic property of the dressing applied to his provender."

*This was written shortly previous to passage of laws against filled cheese.

LEGISLATION RELATING TO IRRIGATION.

BY CLESSON S. KINNEY.

IN the case of *Puttnam vs. Curtis et al.*, recently decided by the Court of Appeals of Colorado (43 Pac. Rep. 1056), it was held: The respective interests of different persons in the same irrigation ditch cannot be adjudicated in a proceeding under the general statute of Colorado, section 1766, authorizing proceedings to determine the priority of right of appropriation of water as between different ditches in the same water district.

ABANDONMENT OF RIGHTS.

It was also held in the case last above referred to, that the non-appearance of the owners of an interest in an irrigation ditch in a proceeding under section 1766 of the general statute of Colorado, to determine the priority of right of appropriation between it and other ditches in the same water district, does not show an abandonment by the owner of his interest.

RIPARIAN RIGHTS—RIGHT TO PUMP WATER FROM A STREAM.

In the State of California, both rights acquired by appropriation and rights of riparian owners are held to be valid. In the case of *Charnock et al. vs. Higuerra et al.*, decided by the Supreme Court of that State, it was held that a riparian owner may pump water from a stream for irrigation purposes, provided that he takes no more than his proportionate share, the method of diversion being immaterial; and that the amount of water which a riparian owner may take for irrigation purposes is not limited to that necessary

for land to which the water may be led in ditches by force of gravity, but extends to the taking by pumps or otherwise, of water necessary to irrigate lands above the level of the stream.

SUBTERRANEAN WATERS.

In the case of *Gould vs. Eaton et al.*, decided by the Supreme Court of California, on March 21, 1896 (44 Pac. Rep. 319), the court held that percolating waters belong absolutely to the owner of the soil, and that his title thereto is not affected by the fact that an impervious strata beneath, and on which the porous strata containing the water rests in close contact, diverts the course of percolation to and over adjoining land into a natural stream.

Mr. Justice Harrison, in rendering the opinion of the court in the above case, said:

"The rule is well established that the principles of law which govern the right to waters flowing upon the surface of the earth are inapplicable to waters which are beneath its surface and percolate through the soil. The water which is held by the soil is a portion of the soil itself, and belongs to the owner of the land, as fully as any other ingredient of the land. *Hanson vs. McCue*, 42 Cal., 303; *Railroad Co. vs. Dufour*, 95 Cal., 615; 30 Pac., 783. This rule is not changed by the character of the material through which the water percolates—whether it be loose sand or a more compact sandstone. So long as the water is in a condition of filtration or percolation, it is a part of the

soil, and subject to the sole dominion of the proprietor of the land in which it is found. The appellant does not dispute this proposition of law, but contends that it is inapplicable to the present case, inasmuch as it appears from the findings of fact herein that, by reason of the seam of clay which separated the strata of sandstone, and which is impervious to water, the waters which had, up to that point, been in a state of percolation through the sandstone ceased to be in percolation, and thereafter passed along the seam in the direction of the creek; that this constituted a defined stream of water beneath the surface, and is to be governed by the same laws as govern streams upon the surface of the earth. This conclusion, however, necessitates the inference of a fact from the findings which has not been made by the court, and which will have the effect to defeat the judgment which the court has rendered. The inference of one fact from others, unless such fact is a necessary conclusion from those others, must be made by the trial court; and, if the facts that it has found are such as might authorize different inferences therefrom, it will be assumed that the inference made by the trial court was one that will uphold, rather than defeat, its judgment. *Breeze vs. Brooks*, 97 Cal., 72; 31 Pac., 742.

The court has not found that there is any flow or stream of water at the seam of the stratum, nor do the findings which it has made authorize such a conclusion. As it must be assumed that the stratum of sandstone is uniformly porous, and extends close to the seam which limits it, it must follow that the water within that stratum is in a state of percolation until it is arrested by the seam, and is thereafter, by reason of gravitation, diverted toward the channel of the creek. The mere diversion of its direction does not, however, change its character from percolating water to a flowing stream. So long as it is within the sandstone, although the lower part of the stratum may be more highly charged with the water than the upper part, it merely percolates through the sandstone until it is freed at the outcropping of the stratum where it borders upon the stream. It is frequently the case that the course of percolating waters is in some definite direction, but the owner of the land in which they are found has the exclusive dominion over them, and does not violate the rights of another by appropriating them to his own use, even though the effect be to divert their course from adjacent lands, or to destroy the advantages therefrom previously enjoyed by an adjacent proprietor. The judgment is affirmed."

BEET SUGAR FACTORY IN NEW MEXICO.

(From the New York Mail and Express, May 9, 1896.)

THE beet sugar industry of the United States, though it has made rapid progress during the past few years, is still in its infancy; and this for the reason that the importance of the beet as a source of sugar has not been generally recognized in this country. It is a fact that three-fifths of the world's product of sugar is derived from the beet; and the very insignificant part which the United States as yet plays in this industry is shown by the further fact that it contributed but 30,000 tons to the world's production of 3,560,000 tons of beet sugar in 1895. The United States imports over 80 per cent of the sugar it consumes, and this in 1895 amounted to 1,587,000 tons, for which it sent abroad upward of \$100,000,000. Since this sugar

comes from countries which buy very little from the United States it has to be paid for mostly in gold. If the United States should produce all its own sugar, this annual demand for gold would be relieved by nearly as many dollars as twice our whole production of the yellow metal. That this annual drain will be rapidly reduced when it is learned that the sugar can be produced at home and yield handsome profits both to the grower of the beets and the manufacturer of the sugar, goes without saying; and it seems equally certain that one of the very important centers of development for the new industry will be the Pecos valley in South-eastern New Mexico.

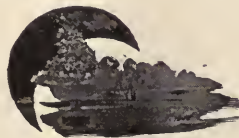
The soil and climate of this valley are

wonderfully adapted to the cultivation of the sugar beet, which here attains a higher perfection, both as regards the percentage of saccharine matter and the yields per acre, than anywhere else in the United States or Europe. Sixteen per cent. sugar and twenty tons to the acre are average results secured throughout the valley, while 20 per cent sugar and thirty tons to the acre are by no means exceptional attainments by the Pecos valley farmer. Single beets have been analyzed yielding as high as 23.75 per cent. sugar. The significance of these results will be understood when it is learned that the average elsewhere in the United States and Europe does not exceed 13 per cent sugar and twelve to fourteen tons per acre. Moreover, from the practically winterless climate of the Pecos valley and the absence of destructive frosts, beets can remain in the ground throughout the winter without harm to their saccharine value. Instead, therefore, of being compelled, as elsewhere, to handle the season's crop in from sixty to eighty days, the Pecos valley factory can run at least 150 days, producing a proportionately greater amount of sugar and yielding a proportionately greater profit upon the capital invested. The Pecos valley, therefore, possesses very manifest advantages in the manufacture of beet sugar, and there appears ample basis for the belief that it will be the center of a very considerable development of this industry in the near future.

The factory now in course of erection in the Pecos valley is located at Eddy, New Mexico, in the center of the valley, and is only the seventh to be established in the United States, while in Europe there are about 1,450. It will have a capacity of 225 tons of beets per day, and will produce from 7,000,000 to 9,000,000 pounds of refined granulated sugar each season. The farmer and the factory will share in the profits of the business. At \$4 per ton, which is the price paid for beets delivered at any station on the Pecos

Valley Railway, the farmer should clear all the way from \$35 to \$75 per acre on his crop. Two thousand acres will be raised the present season in this valley, and it is not an unreasonable expectation that this acreage will be increased tenfold within the next three years.

The results achieved in the Pecos valley place it in the foremost rank of the world's greatest irrigation systems. An ample and unfailing supply of water for irrigation has been applied to a soil of marvelous depth and richness, and these are supplemented by a climate warm and sunny and eminently friendly to plant growth, with the result that the wonderful transformation from arid waste to verdure-clad field and garden is rapidly taking place. Of the 300,000 acres or more that will ultimately be reclaimed under this great system, 75,000 acres are already in the hands of settlers, fully one-half of which is under cultivation. Most of the grasses, grains, vegetables, berries and fruits of the temperate zone grow in utmost luxuriance in this garden spot, as do also the fruits of the temperate and semi-tropical climes, with the exception of the citrus. The range of products is remarkable; the apple and the semi-tropical grape alike attain highest perfection. Many of the most valuable forage plants, and especially alfalfa, yield enormously, making the raising and fattening of cattle, sheep and hogs a most profitable industry. In short, this fertile valley, with its magnificent water supply insuring unfailing crops, would seem to offer the largest opportunity to the farmer and horticulturist; while its climate, which is dry and warm and sunshiny, is not only delightful practically throughout the year, but is also notably healthful and health-restoring, curing or alleviating many chronic diseases, including consumption and nervous prostration. The Pecos valley is destined to become one of the noted health resort centers of the United States, ranking with Colorado and California, and surpassing these in some respects.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

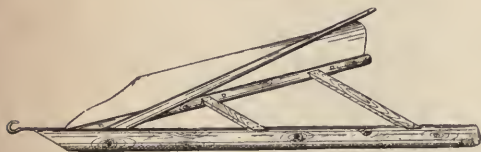
The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

A DITCH CLEANER.

BY JOEL SHOMAKER.

ONE of the most useful of home-made farm implements is a ditch cleaner made by a Utah man. It consists of the forks of a tree cut about ten feet long, on one side of which is a share of sheet iron. The plow is heavily weighted and pulled through irrigation ditches, canals or creeks by horses. It throws out gravel and mud in a most wonderful manner. Two men with four horses can do the work of half a hundred ditch men with shovels. This man owns about six miles of ditch and can clean it out every spring quicker than co-operative ditches with thirty men are cleaned.

The ditcher is a funny-looking machine and one not knowing what it is used for would have to guess many times. A tree trunk about ten feet in length and one foot in diameter was cut so that a smaller limb would project at an angle equal to the figure V, making the back opening about three and one-half feet. The main trunk was hewn down smooth on the outer surface and the limb cut sloping from the top to the outside. Stanchions were set in both, so as to make cross braces. On the sloping side was tacked a flaring piece of sheet iron made much in the shape of a plow share. Weights were put on the front and on the cross pieces. A long pole, probably fifteen feet in length, extended from an iron band in the front, over the top and behind.



A DITCH CLEANER.

The pole is used to raise the front of the ditcher when necessary. A man swings his weight upon the back and thereby lifts the front or points from the mud. A big hook is bolted on the top to which, by a long chain, the double-trees are attached. In ordinary work two horses can pull the ditcher, but in most cases where the ditches are filled with mud and gravel two teams are necessary. To strengthen the plow and make it more substantial, braces of iron could be put in, extending from the center cross beam to either runner, as in a sleigh. The machine is primitive and a mere emergency makeshift, but contains the elementary principles for a fine ditcher.

In constructing new canals it has no equal, considering the expense of making. For cleaning drains the machine is of equal benefit as in clearing ditches. The eastern farmer needs such a cheap, handy implement as well as the western irrigator. There is no patent on the idea. Some six by eight good oak timbers will make a better ditcher than an old tree. Creeks that overflow can be cleaned by one of those machines so that a channel will be cut by the next freshet. Fields can be easily drained of surplus water by plowing furrows and cleaning the ditches with this home-made implement.

FATTENING HOGS ON ALFALFA.

BY F. C. BARKER, OF NEW MEXICO.

MOST of our Western farmers were originally induced to embark in alfalfa farming by the tempting prices offered for the hay in the neighboring towns. But these markets rapidly became overstocked, and as alfalfa could not stand the high rate of freight necessary to get to more distant points, prices pretty generally fell to \$6 per ton, baled

and delivered onto cars. At this figure there is comparatively little profit, especially where land and labor are dear. Long ago I pointed out that this would be the sure result in every alfalfa raising country, and that the solution of the difficulty was to be found in feeding the alfalfa to stock.

Alfalfa is an excellent basis of food, both for milch cows and fattening steers, but in other cases it must be supplemented with other food, containing an excess of carbohydrates, that is heating and fattening ingredients, in which the alfalfa is deficient. In the case of cows, bran is most generally used, while for fattening others, corn and sorghum fodder has given the best results when mixed with an equal quantity of alfalfa.

For growing animals, however, alfalfa is an ideal food, without the addition of any other matter. It is on this account that young pigs do so well on alfalfa pasture. Many of these will get to over 150 pounds in seven months, with nothing but alfalfa, except during the last three weeks when it is advisable to add wheat shorts to their food, mixing 100 pounds of shorts to 500 pounds of alfalfa hay, which should be chopped up with a cutter and fed wet and well mixed up. Of course, corn or corn meal might take the place of the shorts.

To pasture hogs on alfalfa successfully, it is necessary to observe certain precautions. In the first place you need two pastures, so that one may be fed while the other is being irrigated. Be careful to have a good border between the two pastures, for if water comes into the patch where the hogs are feeding they cannot resist the temptation to root in the cool, moist earth.

The best means of preventing the hogs from rooting up and eating the alfalfa roots is to cut the hard gristle of their shorts. No amount of rings will prevent them.

One of the most important points is to see that the hogs have a constant supply of fresh drinking water. Hogs will not thrive if the water emits a stench. Even the pools they wallow in must be changed every week, and they should have a little coal oil and sulphur put in daily, so as to keep off vermin. It is a good plan to nail slats about six inches apart over the feeding and drinking troughs. This pre-

vents the hogs from getting into the troughs and wallowing in them. Cleanliness is all-important in hog raising.

Quarters should be provided in separate pens, should the pasture become wet with rains, as they will tramp out and ruin the alfalfa if the land is very wet. It is also very desirable that sunshades be provided.

While kept in the pens a little sulphur should be put in their feed, and also sulphur and coal oil and a solution of carbolic acid sprinkled over where they sleep. They should also have access to charcoal.

Under the above treatment our hogs in this vicinity are kept perfectly free of disease.

If the sows farrow in March or April the young pigs can, in this climate, be put upon the pasture at once and they will be fit to market in November or December, and the pastures will supply enough green food for the brood sows during the winter.

I have not said anything about the fences; but, of course, these must be hog-proof.

By the bye, the alfalfa in a hog pasture should be mowed once or twice during the summer, or whenever it begins to get hard and woody. This will provide plenty of young and tender herbage, which is more nutritious than forage from other plants.

As regards the number of pigs that may be allowed to run on each acre of pasture, of course this will depend upon circumstances. The best authorities say from ten to twenty head per acre; but at a conservative estimate of ten hogs to the acre it will be seen at a glance that the alfalfa will produce far more money, with less labor, than if the alfalfa is sold, baled, at \$6 per ton.

Hog raising on alfalfa will be one of the staple industries of the irrigated West, and I believe that in no part of the world can pork be raised so cheaply, or the animals be kept as free from disease.

HOW TO GROW WINTER GRAIN WHERE HARD WINDS BLOW.

BY CLINTON C. HUTCHINSON.

THE subject of this article is one which has interested the writer many years. In my "Resources of Kansas or Fifteen Years' Experience" published 1891, there is a description of the soils of the region known as "The Plains," which includes a

large proportion of the vast area between the Missouri River and the Rocky Mountains. Of this country, including Southern Nebraska and southward into Texas, I said: "With *deep plowing and deep and early drilling of the seed*, this is to be the great winter wheat storehouse of the nation."

The crops of several succeeding years confirmed this prediction, as the people were favored with what are known as "good years." Such seasons are to a certain extent detrimental to the permanent prosperity of any new country, because whatever is planted grows and thrives, whether properly plowed and tilled or not. The consequence is that farmers cease to study their new conditions, and ignore all suggestions looking to better methods, or the introduction of new crops suited to their new soil and climate.

The practice of harrowing or drilling winter wheat between corn rows is often so successful that many said deep plowing was unnecessary, and others who plowed deep said this only loosened their soil to a greater depth for the wind to blow away, cutting off the wheat leaves, and perhaps leaving the roots exposed to wind, sun and frost.

The theory which I would urge for trial—for it has never been tried to my knowledge—is based upon certain well-known facts. Winter wheat which is protected by corn stalks, high weeds, fences, hedges or groves, often yields a fair crop, while unprotected fields, under otherwise similar conditions yield little or nothing.

What I urge for trial, not only in Kansas but in all open countries where winds blow, is as follows:

Early in the fall plow deep and harrow fine. Neither hard ground nor lumps and clods furnish proper conditions for tender plant growth. Into this seed bed drill or harrow winter wheat, barley, oats or rye, and with it, or immediately thereafter put in one or two bushels per acre of any quick growing variety of Indian corn. The latter will quickly outgrow the small grain and if sown early enough will thoroughly protect the crop. Being cut down by frosts it cannot sprout again the following spring, and it will mulch and save the growing grain. Its broad smooth leaves will present a surface to the wind, which may be compared in its effects to the pouring of oil upon water in a storm at sea.

If this theory is correct, its value can hardly be estimated. In almost every portion of the United States there is always rain and sunshine enough in the fall of the year to insure a growth of small grain and of the corn, and the mulch of the latter will not only protect the grain but benefit the soil, when plowed under the next year. Just what amount of corn should be sown can only be determined by experiment, and it might be better to have a dropper attached to the plow beam and turn under the corn unless the plow runs too deep. There is not much likelihood of the plow covering the corn too deep; and putting in the grain afterward, even if the corn had come up, will help rather than hinder its growth.

WINDMILL CAPACITIES.

A CAUTION BY H. V. HINCKLEY.

REFERRING to the table on page 245 of the June AGE; I cannot allow such a table to go out to prospective pump irrigators without cautioning them on the following points: The average wind velocity in Western Kansas, for example, is eleven miles an hour giving about one-half the power of a fifteen mile wind. A successful irrigator will need one foot of water in 60 or 90 days instead of in 300 days. In other words, the areas given in column "Amount of land covered," if divided by ten, will be approximately the areas successfully irrigable. Thus a fourteen foot mill, lifting water 175 feet, will irrigate 2.3 acres instead of 23 acres. The actual results will depend upon the man, the layout of the plant, succession of crops and the like. It will be possible to double the acreages given by my rule but the result will oftener fall under my figures. I speak from the compiled experience of many irrigators.

ASHES AS A FERTILIZER.

HARDWOOD ashes make excellent fertilizing material, chiefly for the potash which they contain. Such ashes also contain lime, which is valuable on some soils, but hardly necessary as yet in very many fruit orchards. In buying ashes then, the main question is that of the potash they contain, and if the cost be more than that of potash in some other form, there is little or no profit in the purchase of ashes

for a field or orchard fertilizer. Professor Massey has shown in the "Canadian Horticulturist" that the great trade between Canada and the United States in Canadian ashes is profitable only to the transportation companies and the dealers. There is no profit in the business to the farmer who sells the ashes from his farm in Canada, or to the farmer who buys it for use as a fertilizer in the United States.

He found that ashes costing about \$5 per ton in Canada were sold at certain points in the United States at \$15, the difference of \$10 per ton being largely made up of freight charges. In such cases Professor Massey found that the Canadian farmer was selling potash from his land at two cents a pound, and that the United States farmer was paying more than six cents a pound, whereas he could get the same substance in other forms at from four and a half to five cents a pound. The business may be thus summed up: At the prices named the Canadian farmer cannot afford to sell ashes, and the United States farmer cannot afford to buy.

We sometimes see advertisements of hardwood ashes guaranteed to contain five per cent of potash, and a good many tons have been bought for use in American orchards. Of that grade of ashes, a ton would contain 100 pounds of potash, worth not to exceed \$5. From this it will be seen that he who pays much more than \$5 for a ton of ashes for fertilizing purposes pays too much.

The amount of muriate of potash imported in 1894, was 101,597,074 pounds, valued at \$1,540,081. All other forms of potash, except chlorate and nitrate, 28,623,629 pounds, worth \$702,269.

Of nitrate of soda (Chili saltpeter) the importations in 1894, were 98,136 tons, valued at \$3,189,084.

PROFIT IN RAISING LARGE FRUITS.

IN harmony with what THE IRRIGATION AGE has taken occasion to urgetime and again, upon deciduous fruit growers in general, the following from the "Canadian Horticulturist" is of interest:

The material composing large fruit is less costly than that which enters into the composition of small fruit. We use the terms large and small fruit to distinguish specimens of the same variety, as large Lombard plums and small Lombard plums, not to distinguish plums and cherries from grapes and currants.

Composition of Fruit.—Like other vegetable products, fruits are mostly composed of oxygen, hydrogen, nitrogen, carbon, potash, soda, magnesia, lime, phosphoric acid and sulphuric acid. With the exception of nitrogen, potash, and phosphoric acid, all these elements are abundantly supplied by the air or the soil. A deficiency of one or more of these three substances impairs the fertility of the soil, which must be restored and maintained by compounds containing one or more of these three elements. Each crop taken off the land carries with it a certain amount of these three elements, and lessens by so much the raw material at the command of the farmer.

Let us apply these principles in reckoning the cost of producing large and small fruit of the same variety. An apple three inches in diameter contains twenty-seven times as much substance as one only one inch in diameter, but the skins, cores, and seeds form a much larger percentage of entire substance of the smaller apple than of the larger one.

By a chemical analysis of the apple we find that the seeds, skins, and cores contain about twice as large a percentage of ash, and five times as large a percentage of nitrogen, as the flesh of the apple does. Not only is the ash of the refuse in greater abundance, but it is also richer in phosphoric acid. These facts show that the soil is more rapidly exhausted by the production of small fruit.

Injurious to the Tree.—The tree is more injured by a large crop of small fruit than by an equal weight of large fruit. The fruit tree which bears a heavy crop of small fruit makes very little growth of wood, while one which bears the same weight of large fruit makes sufficient wood-growth. Both the growth of the tree is retarded and its health is much impaired by an undue amount of seed. Besides this, the raising of large fruit is more profitable, because it commands a higher price in the market.

An Ingenious Safeguard.—George A. Fleming, a fruit grower of Visalia, Cal., has devised so ingenious, simple and efficacious a scheme for protecting orchards from frost that it should be known as widely as possible, says the *Call*. It should be borne in mind that frost occurs only when the air is still. Hence fires built around an orchard will send their heat and vapors straight up into the air, while building them among the trees would be dangerous.

Mr. Fleming, after various experiments, hit on the following plan. He thus describes it: "We built wire frames on our low truck wagons, stretching them from four wagon stakes and heaping wet manure over them. Dirt was thrown on the wagon beds to protect them, and pots of burning tar were set underneath the straw roof. A barrel of water on the wagon was used to keep the straw wet. These

wagons were driven about and did the best work, as they could go wherever most needed. The smoke and vapor were carried to the rear as the wagon moved, and, being at once out of the rising heat, fell close to the ground in a long white trail. At daylight our whole 400 acres of orchard was covered with a white fog extending from the ground about twenty feet high."

That seems to be a perfect solution of the problem. The wagons may be driven among the trees or anywhere else, and the blanket of vapor left behind is a sure protection against frost. The idea is economical, the question of fuel being one that every grower can answer for himself.

Pear Blight in Texas.—Mr. H. M. Stringfellow some years ago planted an extensive pear orchard at Hitchcock, between Houston and Galveston, Texas, and for some years it was reported to be absolutely free from blight and the most profitable orchard of the kind in the country. But all that has changed. It has been found that what Mr. Stringfellow believed was an ideal location for pears was soonly for a short time, and that now the trees in that locality of which great numbers have been planted, are subject to the disorders which affect such trees elsewhere. From a letter in the *Texas Farm and Ranch* we take the following:

"I am just in from Houston and while there took a run down to Hitchcock to see the Stringfellow pear orchard. I was anxious to see how that fine pear orchard had fared, while blight was everywhere playing havoc with pear orchards. I found the old original orchard badly affected; the Kieffer worse than I have ever seen it here—which so far has been almost clear of blight. Le Conte was as badly affected as here. I was exceedingly sorry to see this. Thousands of trees of these varieties are planted and being planted around Hitchcock, Loma and Alvin. It is a grand sight to a fruit man, but when we think of the blackened ruin that it must come to in a few years, it makes us sad. We also saw the Satsuma orchard set out by Mr. Stringfellow, dead to the ground, on the trifoliate stock. But when we think of eighteen inches of snow lying on the ground for several days it is no wonder that orange trees, even of the most hardy type died.

Calomel for Pear Blight.—The question of administering calomel to cure pear blight is attracting some attention in the Eastern States, and in this connection we give the gist of the claim made for this prescription by Dr. Hensley before the

Missouri State Horticultural Society some three years ago. The doctor alleged that the remedy had been successfully tried for twenty-two years, and he regarded it as practically infallible. He alleged that it had invariably cured the disease whenever tried. The dose recommended is five to ten grains administered by cutting the bark across the trunk and longitudinally, as in the operation of budding, turning back the bark, inserting the calomel, then closing the wound and tying it in place by means of a bandage.

While the lay mind may possibly be inclined to skepticism regarding the efficacy of this treatment, it can be easily tried by any one and the matter fully tested. The medicine should be applied in the spring when the sap is flowing freely.

Copper Sulphate as a Fungicide.—Professor Taft, of the Michigan Experiment Station, has much faith in copper sulphate as a winter spray for fungous growths of various kinds. He says:

"It is now about three years since a strong solution of copper sulphate first came into use as a fungicide upon the bare branches of trees before the buds opened, and the results obtained from its application have been so favorable that it is recommended by nearly, if not all, of the spraying calendars. When used at the rate of one pound to fifteen or twenty-five gallons of water, it destroys the mycelium of such fungi as winter upon the branches, and prevents the germination of such spores as may come in contact with it; but at this strength it will destroy the foliage, hence it cannot be used later in the season."

Prune Acreage in the Pacific Northwest.—In its splendid "Prune Edition," the "Rural Northwest" gave valuable statistics of the industry in Oregon, Washington and Idaho. From careful investigation the "Rural" has learned that prunes are grown in 20 counties of Oregon, in acreages ranging from 20 acres in Curry county to 5,000 acres in Douglass county. The total for the State is given at 28,370 acres. Washington produces prunes in twenty-seven counties, and the smallest acreage in any county is fifty acres in both Columbia and Kittitas. The total acreage is 11,500 acres. Six counties in Idaho produce prunes in quantity, and the total acreage is 6,450 acres, of which Ada and Canyon counties have 4,500 acres. Total for the three States, 46,320 acres of prune orchards.

Crops of Russia 1894.—Russia is a formidable competitor of the United States in the grain markets of the world, and a wide area is there devoted to the cultivation of cereals. Although too far north to yield Indian corn in great quantity, Russia's wheat fields are extending rapidly, and the early completion of the trans-Siberian railway will no doubt stimulate wheat production very materially to the disadvantage of the United States, for the wheat produced on cheaper land than ours, and with the ex-serf labor of Russia, can certainly be sold cheaper in the world's markets than any that can be grown in the United States under civilized conditions. Last year's Russian crops follow.

	Bushels
Winter wheat.....	78,948,626
Spring wheat.....	203,693,413
Rye.....	821,534,904
Oats.....	687,876,308
Barley.....	186,718,218
Buckwheat.....	43,309,650
Millet.....	33,642,645
Maize.....	13,222,320
Peas.....	16,209,850

Condition of Crops in Spain.—During eight months previous to May 1, Spain had suffered from severe drouth. In March and April there were but two days of rainfall. Crops were threatened with almost total failure, and the poor with prolonged distress. But in May the drouth was broken with copious rains, accompanied by a windstorm something less than the St. Louis variety. Farmers feel encouraged, but there will be a short crop of wheat. The American consul at Denia, Andrew F. Fay, suggests that this is an opportunity for the United States to increase its exports of wheat to Spain, which has purchased abroad during the past seventeen years 126,666,600 bushels, or an average of 7,450,900 bushels per year.

Make Careful Selection.—A fruit tree that produces one dollar per annum is easily worth five dollars, making all due allowance for care and depreciation. If the same tree produces two dollars worth it is equally as well worth ten dollars. If there are sixty trees on an acre the difference in the value of that acre is as between \$300 and \$600. If there are one hundred trees to the acre the difference is as between \$500 and \$1,000. A due appreciation of this difference will cause every tree planter

to be exceedingly careful in the selection of varieties. We hear of single acres yielding enormous returns; it is generally due to the superior quality, and consequent fancy price of its fruit. It costs but little, if any, more to plant and care for the choicest varieties of any fruit, which have standing in the market and a ready sale, than for those which are only fit for stock feeding, and of trifling value for that.

Overproduction.—Commenting on the advice sent out from the Department of Agriculture, at Washington, that "the American farmer must change his way of doing business and put more brains into his work," the Denver Field and Farm says: "The American farmer has put so much brains into his work that he has, according to his political guardians, brought on universal distress throughout the country by producing too much. Overproduction is what ails the country, he is told, and yet he must put his brains to work to produce more. Our opinion is that he should put his brains to finding out just who it is that is robbing him of the fruits of his toil. He had better watch the money changers; the temple is full of them."

Feeding Alfalfa.—An experiment, carefully conducted at the Utah agricultural station in feeding alfalfa cut at different stages of its growth, has shown that steers fed on that which was cut just before coming into bloom made a gain of three-fourths of a pound a day. A second lot fed when the grass had been cut in the early bloom made a gain of only one-half a pound, while a third lot fed on late cut hay, after it was out of bloom made an average gain of only one-fourth of a pound per day. There is a lesson worth heeding in this. If you neglect your haying when the grass is just fit to cut, you are letting the dollars run away from you.

Hog Raising.—At the present low price for hogs the raising of them can only be profitable where most favorable conditions exist. Those who can make anything now, or who can make most when the market conditions are normal, are those who are in position to produce suitable hog feed at the least cost and where the attendance of the animals is least expensive. It is here that the irrigated farm has a de-

cided advantage. Alfalfa, kaffir corn, potatoes, sugar beets and other feed can be produced with certainty and at least possible cost.

Advantages of a Creamery.—If a hundred farmers make the butter from five hundred cows, there will be one hundred different kinds of butter, and some of it will not be good—it may pretty safely be said that *much* of it will not be good. But if the milk be brought together and manufactured in a well conducted creamery the entire product may be of the best. If it be sent to market as the product of the one hundred makers, the poor will have undue influence and depreciate the price of all, while the creamery will obtain the top price for all.

Miles of Travel.—In cultivating forty acres of corn, or other crops, planted in rows three and a half feet apart, the team must travel ninety-five miles. To plant and properly cultivate forty acres of corn will, then, require about 350 miles of travel. The farmer who thinks of this and appreciates its significance will try to get the same amount of crop off twenty acres and save half the travel. The time saved will permit of doing a great deal for the permanent, as well as temporary improvement of his land.

Good Roads.—Farmers grumble at a trifling road tax and shirk in every way when the law compels them to tax out their tax, yet there is no public taxation of such direct benefit to themselves. If viewed in the proper spirit the road tax will be the most cheerfully paid of any, and any farmer who has to use the roads he works, can well afford to give two days of honest work for every one the law requires. All that is needed is the proper disposition.

When to cut Alfalfa.—Tests have proved that alfalfa cut when it is in fairly full bloom is most nutritious as hay, or at least, produces the best results in feeding. If it is cut at that time there are other advantages of great moment. It will make another full crop in the season, and the new growth will start much quicker after the cutting. It is therefore worth while to watch closely and be ready to cut it just at the right moment.

Young Pigs Best.—A few years ago heavy hogs were in active request in the markets. Twenty years ago the average weight on the Chicago market was 300 pounds, but now it is hardly more than 230 pounds. Consumers have learned, in all parts of the world, that the quickly fattened pig less than a year old, makes the sweetest and most desirable pork meat.

Shipping Horses to Europe.—W. A. Hogan, of Jones county, Iowa, relates his experience in the *Alamosa Journal* as to a recent shipment of horses to Switzerland. He visited Lucerne and Basel. He says the supply of horses is short in Europe, and that a horse fit for carriage or saddle sells for \$200 and upward. The success was sufficient to justify another shipment.

Johnson Grass.—An exchange says that keeping Johnson grass cut off as soon as it appears above the surface of the ground will kill it. It may be so, but the farmer who begins when the first shoot makes its appearance will be the one most likely to succeed in thus eradicating one of the worst pests that was ever established in good land.

Gardening for Profit.—In successful market gardening the aim should be rather to produce the largest possible crop on the amount of land there is to cultivate. A large crop means a crop of good quality, too, in nearly all cases, and that is the only kind that brings the best price in the market. There is more clear profit in one acre well cared for than in five acres half taken care of. Next in importance to well prepared land and good seed is the proper plan or arrangement of the crops to be grown.

Ram Lambs.—The authorities are often asked for the number of ram lambs to place in a flock—that is, how many ewes should be allotted to each sire. A robust ram lamb may serve twenty or thirty ewes. More than that number will check the growth of an ordinary ram lamb.

Pedigreed Live Stock is having its day with good farmers and that day has not come any too soon either. If good keep, good surroundings generally, and intelligent selection are forces having any good

effect upon animals descended from the well kept herds and flocks of the country there can be no question as to the fact that all intelligent and honest breeders are on the royal road to permanent success, not only for themselves but for the live stock industry as a whole.

Washing Butter.—There is considerable difference of opinion in dairy circles on the subject of washing butter, the camps being divided into the washers and non-washers. Those who advocate the reduction of washing to the minimum claim that much washing injures the flavor.

Hemp.—Dr. W. H. Dunn, who raised 300 acres of hemp near Lincoln, Nebraska, is now working the crop into tow, which he will ship to eastern markets. He announces his intention of raising 1,000 acres next year.

Maple syrup from corn-cobs is the latest. By this discovery the cobs are worth more than the corn. Frank Shafer, of Lacon, Ill., boils clean cobs in water until soft. Then the juice is strained off and dark brown sugar added. This is boiled and it comes out a fine quality of maple syrup. It is also discovered in Iowa, in this instance, that a syrup can be produced from watermelons. The past season a melon grower in that State thus utilized thousands of surplus melons which in other seasons he has allowed to rot on the vines. The melon syrup has an exquisite flavor, has good body and a beautiful color.

Ginseng is being grown in Illinois. This root is worth almost its weight in gold. The Chinese regard this plant as a cure for almost every disease. They believe that the root possesses intelligence and powers of locomotion which enable it to run away to escape capture. They also believe that it is guarded by the tiger, the leopard, the wolf and the snake, animals appointed by the gods to protect it.

Australian salt bush has been tested in California and is a great success, growing to perfection on alkali ground where nothing else can grow. It is, like alfalfa, perennial, and everything that eats alfalfa

will eat it. A pleasant flavor is given by it to both butter and milk. If the California Agricultural College report can be relied upon this new grass or fodder will make vast tracts of worse than useless land the most valuable for dairy purposes.

An Illinois farmer living in Jewell county has discovered that seed corn soaked in coal oil renders the growing corn chinch-bug proof. He plowed up his wheat and planted the ground with corn. The seed of five acres was soaked in coal oil and the other forty was not. The bugs ate up the forty acres and never touched the five acres. It is worth a million if true.

Speaking of the great crops of North Dakota and the northward movement of the corn belt, B. S. Russell, of that State, advances a theory that is startling in its novelty. He insists that wheat is the pioneer of all cereals. Its office is to go ahead and serve as the civilizer of the soil; that is, to take the wildness, or, as he puts it, "the Indian disposition," out of it. He states as a fact that there were few instances where corn had been successfully raised until the land had first been cultivated in wheat.

Twenty-one thousand acres of land in O'Brien county, Iowa, forfeited by the Sioux City & Minneapolis Railroad Company, will be thrown open to settlement Feb. 27. Eight thousand acres will be taken by settlers who were driven from their homes when the government gave the lands to the railroad, but who are given the first chance at the land under a recent law.

It is alleged by the "Sugar Planters' Journal" of New Orleans, that many of the sugar plantations in that State have not realized 125 pounds of sugar per ton of cane, because of the use of antiquated machinery and appliances. There is a general need of replacing this old-time apparatus by the most modern type of sugar machinery, and the Louisiana papers are urging a forward movement on this line.

Some species of fish and insects do not sleep. Among fish, the salmon, pike, gold fish and some other species are known not to sleep at all, but some kinds of fish in-

dulge in periods of rest for an hour or two at a time. Certain species of fly are known not to sleep, and all the animalculæ belong to the list of those which sleep not, says the Scientific American.

Every man who plants trees should remember that in the present day and age nothing but the best fruits and vegetables pay to grow and ship; and when that is taken into account, the advantage of irrigation, which will insure a crop every year and multiply the productiveness of the land from two-to fivefold, becomes the more apparent.

The average production of peas in the Province of Ontario is about 14,000,000 bushels from an average area of 700,000 acres. Much of this product finds market in the United States. Much of the land in northern Minnesota, and probably in other parts of the northwest, is equally as well adapted to the growing of peas.

Egyptian planters are rapidly increasing the acreage of cotton planting in the valley of the Nile, and are improving their irrigation facilities for its culture. Irrigation in the southern and southwestern States would greatly increase the production and improve the quality of the crop in this country.

The orchard wagon with low wheels and broad tires, that will turn round within its own length, which will carry a load over soft ground without cutting in, fitted with springs to save jar, wear and horse flesh, has become a necessity where it has become known, and it comes to stay.

General Morin, of France, says that the deterioration of common roads except that which is caused by the weather, is two-thirds due to the wear of the horses' feet and one-third to the wheels of vehicles. Motorcycles and rubber tires would therefore minimize the expense of road repairs.

A red clay road well graded up and packed when dry, with good provision for drainage, can be made one of the best of roads by a coating of gravel, which becomes thoroughly imbedded in and cemented by the clay. It is one of the worst in its raw state.

There is a growing demand for family cows. Whoever produces them and complies with the requirements can get extra compensation for his labor and investment.

Capt. J. P. Casey, of Las Cruces, New Mexico, killed six Berkshire pigs last winter that dressed together 1,100 pounds. They were fed only alfalfa except 65 cents worth of shorts each to finish them off, and the meat was of superior quality.

The spray pump is found to be as useful in the garden as in the orchard, and is even being used to good advantage for preventing and destroying vermin on stock. Weak kerosene emulsion can be so applied as to meet every portion of the body.

Every farmer should raise some pumpkins in the cornfield. It is only necessary to plant the seed when the crop is "laid by," and they will do the rest. They fill a place in the domestic economy, both in the house and in the stockyard.

Dr. A. T. Peters, of the Nebraska State University farm, reports uniform success with the new method of dealing with hog cholera. A bulletin is to be put out, bearing on the subject, which will be extremely interesting to hog men.

Five hundred dollars from a half acre of blackberries, is given as the last year's crop of Mr. H. Blanchard, a New York grower. He thinks it requires the proper combination of man, soil and season, however, to produce such results.

Orange growers in the early belts of California might profit by budding some of the earliest good varieties, such as the Parson Brown, Early Oblong and Nonpareil, which ripen in Florida early in November.

It is said that not a quarter of the usual number of mares were bred this season. Such a policy will not have to be kept up long before there will be a scarcity of horses to meet even the present limited demand.

Fruit that is worm-eaten or disfigured by insects will not command either a fair price or ready sale. It is important to spray your trees and protect the fruit. It does not cost but a trifle of the amount saved.

It is only the excess of what a cow eats above what is required for its maintenance that yields a profit to the owner and feeder. The more they can eat and properly assimilate the greater the margin of profit.

For the garden, if possible, choose ground having a gentle inclination toward the south. Give it thorough drainage, deep cultivation and liberal fertilizing, and you will get good results.

Bubach, Crescent, Haverland, Warfield and Greenville, among the pistillate varieties of strawberries, stand in high favor among members of the Missouri State Horticultural Society.

Professor Bailey recommends a large increase in the area of land planted with apricots in the State of New York, and believes the tree there will prove as hardy as the peach.

Tests prove that grain fully matured and properly cured does not shrink if held during the winter. If not protected from vermin there may be waste, but there is no shrinkage.

In any kind of farming for profit, the problem is to get the largest return from the smallest outlay in the least time. This cannot be accomplished without thought.

The appearance of the corn shocks in the field after a harvest is a pretty good indication as to the character of the farmer, whether he is methodical or a slouch.

There is a big saving of labor and horse-flesh if you can make one acre produce as much as five usually does by intelligent treatment and care, and you can with irrigation.

If crops of any kind are planted between young trees, the irrigator must decide carefully the quantity of water necessary for each and apply accordingly.

Animals and fowls enjoy a fresh, cool drink as well as you do. It is not the best policy to permit their water supply to become warm and stagnant.

"Baby pork" from pigs not more than eight months old and weighing from 150 to 200 pounds to the carcass is now in the best demand in all markets.

Keep accounts with your fields, your animals and your poultry. It is just as necessary as for the merchant to keep accounts with his customers.

A duck lays large eggs, and nearly every day. It should have an ample supply of animal food in connection with grass and ground grains.

The dairyman need not see his lands run down in quality and productiveness unless he is inexcusably neglectful and shiftless.

Cement floors are the best for barn flooring. They are hard and smooth, are easily cleaned, save manure and are rat-proof.

Don't feed the pastures too closely. It is better to divide and use the lots in rotation. It saves vitality for the grass roots.

Spraying should be done effectively. Both sides of every leaf and twig should be thoroughly wet with the mixtures.

The walk is the gait of a horse that should be cultivated and improved. It is especially so as to draft horses.

Ventilate the stable and the poultry house as carefully as you do your dwelling. It is equally necessary.

As you cannot change your climate it is the best judgment to study its conditions and conform to them.

A sound and healthy hen will lay because she can't help it, if you feed her the right sort of food.

No good neighbor will allow weeds to go to seed that may be scattered on the adjoining farms.

Ducks can be raised without a pond if you give them plenty of water to drink and to waste.

Discuss your methods with your neighbor farmers. You will get as well as give good ideas.

When you cannot twist any drops of sap out of clover stalks, it is safe to put it in the barn.

Irrigation will double the production of melon and cucumber vines, if judiciously applied.

A fat hen is a poor layer, and her eggs will either not hatch or will produce weak chicks.

Big corn cobs are not objectionable if there is big corn on them and plenty of it.

The younger you feed a pig, and the faster, the more profit there is in him.

Are your tools in good condition? If not, you may waste time and money.

Droppings left under fowls or animals are the breeding grounds of disease.

MAXIMS FOR THE IRRIGATED FARM

It is a good weed that dies young.

The proper study of the farmer is his farm.

Regularity is a first essential in caring for stock.

Any kind of a tree is a friend of man. Plant them.

The more a thing is worth the more it costs usually.

Good thinking is often a substitute for hard working.

Five acres well worked is better than fifty neglected.

Take care of your business and it will take care of you.

The mortgage is generally the heaviest thing on the farm.

The man who is wise knows best how little he does know.

It is as important to agitate for wide tires as for good roads.

It is sometimes the better economy to spend rather than save.

If you grow poor stock you may be sure of a lean pocket-book.

The best and easiest way of doing things is the most economical.

Slipshod work in any thing never produces satisfactory results.

The less cash a man has, the more necessity to use his brains.

Early training is as good for the four-legged animal as for man.

Good tools and the best machinery are the most reliable farm helpers.

Who abandons an old friend for a new one will not long have any friends.

The farmer who does not begin irrigating is sleeping on his opportunities.

A principle that should never be forgotten by the stock raiser—like begets like.

Cultivators of the soil should not overlook the necessity to cultivate the man as well.

Good treatment for the hired hand will make a large addition to the value of his labor.

Gardening cannot be learned in a day, a week or a year. No more can general farming.

A hard surface is out of place in the corn field, but it is just the thing for the road.

It is the finishing touch in almost every class of productions that yields the largest profit.

It is not good business judgment to buy good seed and plant them carelessly in poor land.

It is well to remember that your horses and cows have nerves, and to treat them accordingly.

The better the fruit the more valuable the tree. Take care, then, in the selection for an orchard.

Road making should begin at home. Well drained and bridged farm lanes are a paying investment.

The man who does not know what is in his soil can hardly be capable of judging what can be taken out of it.

There is no farmer who knows it all, and if he lived to be a century old there would still be something to learn.

By co-operation the farmer can buy at wholesale. If, then, he sells at retail he increases the margin of profit.

Make the farm home more attractive than the city homes if you would have your children stay there contentedly.

The difference of success between one man and another is generally in the quality of the brain rather than the work of the hands.

If farmers generally were educated practically on the farm, and under intelligent teaching, there would be fewer failures among them.

It is the American idea to give all public questions a public hearing, and it is as conducive to agricultural improvement as to political or social.

Many co-operative companies fail because of too much individuality in the management. True co-operation is by rule of the majority, all working earnestly to a common end.

THE PROGRESS OF INVENTION

THE spray pump promises to be as important an invention for the horticulturist as the cotton gin was for the cotton planter.

MR. J. F. DURYEA, the inventor of one of the most successful of the motor wagons, is turning his attention to its application to the farm wagon, and in a form that will permit of its being utilized to drive the wagon, a thresher or the stationary machinery of the farm. He considers it entirely practicable.

D. L. HOLDEN, a New York inventor, has perfected a method for making artificial ice at a cost not to exceed fifty cents a ton. It is an automatic plant whereby the evaporation of ammonia, which passes through large cylinders in a revolving tank filled with filtered water, will produce ice crystals that are compressed into available blocks.

A CARBON harder than the diamond has been discovered by M. Moisson. It is a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of five thousand degrees. It will even cut diamonds, and is likely to supersede them for boring rock, cutting glass, and other industrial purposes. It can be produced in pieces of any required size.

Two machines, perambulating fumigators, have been designed for the United States marine hospital, to be used in exterminating epidemic diseases in cities. One is a chamber in which infected clothing and other articles can be thoroughly saturated with hot steam; the other is a sulphur fumigator provided with apparatus for disinfecting houses, the fumes being driven into the building through rubber hose. These machines can be sent post haste to any house where contagious or infectious disease breaks out.

THE bicycle represents the greatest carrying power, according to its weight, of any vehicle that has ever been constructed. Farm Machinery calls attention to this as a most interesting suggestion to the constructors of vehicles of whatsoever char-

acter. The freight car carries twice its weight twenty miles an hour; the farm wagon carries about the same proportion of load to weight not more than six miles an hour under the best conditions, generally not more than four; the bicycle carries seven to eight times its weight ten miles an hour, and apparently with no greater risk of breakage.

To produce a light without any carbon, such as is used in the incandescent light, is one of the great problems which Edison and Tesla have been striving to solve, and both have announced discoveries in this direction which are big with future possibilities. The principle has been discovered of producing light by electrical vibration, and Tesla claims that 200 times the light can be obtained from the same power. Edison has perfected a lamp which produces the X rays in a form that may be utilized for house lighting—movable lamps. He is simplifying and studying the process of construction, so as to make the invention of commercial value.

THE NEW LIGHT.—Edison announces that he has completely succeeded in producing a new light, which he calls the "fluorescent light." It is simpler than the incandescent and in every way preferable. The same style of globe is used, but the whole globe is aglow with a brilliant white light of wonderful illuminating power, instead of the carbon filament. Crystals of tungstate are welded to the inside of the globe, a partial vacuum is created and the light is produced by molecules of air in rapid vibration striking against the tungstate crystals. A low current of electricity is employed, and whereas in the incandescent light only 5 per cent is utilized as light, there is no perceptible heat from the new light. Its power is greater, at a much lower cost, than any light ever before produced. We have only just begun to get used to the incandescent lights through their general introduction and use, and now comes a substitute, which is likely to supplant them as rapidly as they were originally introduced, from the same inventor.

PULSE OF THE IRRIGATION INDUSTRY

RUSSIAN IRRIGATION.

AMONG the numerous visitors who were brought to America during the World's Fair, many were those who were interested in irrigation. Among them were visitors from Australia, France, Germany, Russia, Finland, and elsewhere. Several of them have since written descriptions of their trips through the West. Professor D. N. Golovneen, of Russia, Member of the American Society of Irrigation Engineers, has embodied the results of his trip in a volume of 100 pages with numerous illustrations, which has recently been issued. It is an extension of an article which he delivered before the Institute of Ways and Communication in St. Petersburg in which he is adjunct professor of hydraulic engineering.

Professor Golovneen expresses the conservative conclusion, "that in consequence of the energetic activity of the government and private men, accompanied with the development of irrigation science among the farmers, American irrigation will not remain in its present, though very high, state of development, but promises a further increase and financial success."

In a private letter to Professor L. G. Carpenter, of the State Agricultural College of Colorado, he states that private irrigation enterprises in Russia are few. Large government undertakings are projected and are being studied by commissions from the Ministry of Agriculture. Though not having new irrigation works, Russia has many ancient ones in her Asiatic dominions, some dating from the earliest times. The areas devoted to irrigation are very great. Some of the canals are very large, and irrigate extensive tracts of country. There are many traces of ancient canals of great magnitude, now abandoned from the encroachment of the sands, or from lack of water, and from stormy times in the past.

Professor Golovneen promises Professor Carpenter that in the future he will prepare a paper on the conditions of irrigation in Russia.



I. N. PEPPER,
of Stockton, Kansas, author of article on "Rooks
County Irrigation," in this number.

RIO GRANDE IRRIGATION AND LAND COMPANY.

WE learn from a private and reliable source that the capital for this concern was actually subscribed in London last month.

The object of the company is to build a dam on the Rio Grande river opposite Engle, New Mexico, and thence irrigate the whole of the Rio Grande valley as far down as Fort Quitman, Texas. Within this district about 50,000 acres are already under ditch and the proposed irrigation works will bring 180,000 acres more of valley land and 300,000 acres of mesa lands under cultivation.

The capital already allotted consists of \$2,000,000 in ordinary shares.

500,000 in 8 per cent preference shares
250,000 in 5 per cent debenture bonds
while \$500,000 of ordinary shares and

\$250,000 of debenture still remain in the treasury.

The directors in London are Colonel W. J. Engledue, Earl of Winchelsea, Lord Clanmorris, Lord Ernest Hamilton, Robert J. Price, M. P., John Ferguson, Dr. Boyd and R. Chetham-Strode.

The local directors are Mr. W. T. Thornton, Governor of New Mexico, Edwin C. Roberts, of El Paso, Texas, Joshua S. Reynolds, President of First National Bank of El Paso, Dr. John M. Yair and Henry D. Bowman, banker of Las Cruces, New Mexico.

The engineer of the company is John L. Campbell of El Paso, Texas.

If successfully carried out this will be one of the largest irrigation enterprises in the country, and later on we hope to be able to give further particulars in regard to the system which the company proposes to follow, and which embraces some features of peculiar interest.

THE AGRICULTURAL EXPERIMENT STATIONS.

Nearly forty-five years ago, a company of farmers joined themselves together in the little German village of Moeckern, near the city of Leipsic, and under the influence of the Leipsic University, called a chemist to their aid and (with later help from government) organized the first agricultural experiment station. Liebig in Germany, Boussingault in France, Lawes and Gilbert in England, and other great pioneers had been blazing the path of progress for years before. A great deal of research bearing upon agriculture had been and is still being carried on in the schools and universities, but the action of these Saxon agriculturists in 1851 marks the beginning of the experiment station proper,—the organization of scientific research and with the aid of government “as a necessary and permanent branch of agricultural business.”

The seed thus sown has brought forth manyfold. In 1856 there were five; in 1861, fifteen; in 1866, thirty; and today there are more than one hundred experiment stations and kindred institutions in the different countries of Europe. Some are connected with the great universities or agricultural technical schools, others are independent and supported by societies.

In each of them, from one to ten or more investigators are engaged in the discovery of the laws that underlie the practice of farming, and in finding how they are best applied.

So rapid and so sure has been the progress of this enterprise in both hemispheres, that private persons, educators, societies, and governments have learned the usefulness and indeed the necessity of these institutions, not for the farmer alone, but for all who are dependent upon the products of the soil. The movement is extending to Asia and to South America;—everywhere, indeed, its importance is coming to be felt.—From “The People’s Food—A Great National Inquiry,” in *June Review of Reviews*.

PROGRESS IN NEW ZEALAND.

WHAT is yet but a hope or prophecy with us, regarding many questions of social and political importance, has become ancient history to the inhabitants of that little island country away off in the southwest corner of the world. Mr. A. D. Willis, a member of the New Zealand Parliament, was lately in this country, and gave the following information to a reporter for the daily press:

“There are over 2,000 miles of railway in New Zealand, nearly all owned by the government. Our system of managing them cannot be beaten. There is no corruption and not a single abuse. The telegraph system belongs entirely to the government.

Then we have a government system of insurance which works admirably. Through this we are abolishing all pensions. All government employes, including those connected with the railroads and telegraph system, are compelled to provide for their own insurance out of their salaries.

Our taxation is based on Henry George’s theory of a single tax on land, but we have also an income tax. Land improved and unimproved pays the same tax. Under our income tax we exempt all incomes under £300 a year, and on incomes from £300 to £1,000 the rate is sixpence per pound. On incomes from £1,000 to £2,000 the rate increases from sixpence to a shilling, and on all incomes above £2,000 it remains a shilling on the pound.

Last year we adopted a system of lending money to farmers, on both free-hold and lease-hold lands, at a low rate of interest, with a 1 per cent. sinking fund, which clears off the loan in thirty-three years by compound interest.

In every way we look carefully to the interests of the mass of the people. Our factory girls are not allowed to work over eight hours

a day, children are not allowed to work in factories under fourteen years of age, and until they have passed through certain grades in the schools. We compel employers in factories to give a weekly half holiday. No shops are allowed to open on Sunday, and every shop must close one day in the week at 1 o'clock in the afternoon. The closing of the shops on Sunday was not at all on secular grounds, but simply to give employes a reasonable amount of rest."

FLOW OF IRRIGATION STREAMS.

THE following information is furnished by Prof. L. G. Carpenter, of the Experiment Station, Fort Collins, Colo.:

The Cache a la Poudre river is a stream typical of those of the eastern slope of the Rocky mountains, and is one of which there is the longest and the most continuous record. A self-recording instrument was placed on the stream in 1884. The years of high water in one stream are usually the same with others, as the meteorological conditions causing a heavy or light snowfall over the mountain watersheds are usually the same. So closely alike are the conditions of melting, that frequently the highest stage of water will be reached by a number of streams on the same day.

Up to the present date, June 17, the Cache a la Poudre has been unusually low, which the reports of light snowfall in the mountains gave reason to expect. So far, the year compares with 1888 and 1889, which were unusually low. The highest water, due to melting snow, was reached on May 29, when there was 1,900 cubic feet per second at the time of highest water of the day. On May 30 and 31 the river was higher, reaching 3,340 second-feet for a short time on the 30th, due to heavy rain. Since then the river has fallen steadily, and the daily fluctuation due to the melting by day and the freezing by night in the upper elevations, is becoming less noticeable. For the week ending June 9, the average was 1,378 cubic feet per second, while the average of the eleven previous years was 2,272 second-feet, showing a decrease of 900 cubic feet per second. For the week ending June 17, the average has been 1,180 second-feet, which is 800 feet less than the average for eleven years. This is 100 feet less than in 1888 for the same time, notwithstanding that in 1896 water is received from the Laramie river by works constructed within the last few years.

The following is the record for the year, and is worth careful consideration. The average only, for the earlier weeks, is given. For the past two weeks is given day by day, and the average for the same time for the previous years also is given:

Week ending.	Ave. 1896.	Ave. prev. y'rs.
May 12.....	*964	856
" 19.....	504	1033
" 26.....	1007	1535
June 3.....	1802	1846
" 9.....	1378	2272
" 17.....	1180	2013
Ave. of y'rs.		
June 10.....	1895.	1896.
" 11.....	2458	1354
" 12.....	2434	1355
" 13.....	2326	1163
" 14.....	2241	1139
" 15.....	2226	1144
" 16.....	2208	1077
" 17.....	2110	1027

Record of week June 10-16—average cubic feet per second:

1884.....	5118	1891.....	2386
1885.....	2626	1892.....	1364
1886.....	2258	1893.....	2515
1887.....	1978	1894.....	2140
1888.....	1280	1895.....	2967
1889.....	1388	1896.....	1180
1890.....	1238		

ARTESIAN WELLS.

THE following valuable and interesting information has been extracted from the volume on Artesian Wells by Walter Gibbons Cox, C. E.:

At the Carthusian Monastery at Sillers, France, is an artesian well still flowing that was bored in the twelfth century.

In Algeria and the Sahara desert 12,-000,000 acres of land have been reclaimed and irrigated by means of artesian wells. The aggregate flow from all the wells is estimated at 80,000,000 gallons daily.

Prussia is credited with the deepest bore in the world, namely, that at Rybuik, Upper Silesia, made by the German government for scientific purposes. The depth to date is 6,565 feet.

In the United States the deepest successful bore for water is in Virginia, where the extraordinary depth of 5,060 feet was reached.

The Winton bore in Queensland, Australia, is 3,995 feet deep with a flow of 1,100,000 gallons daily.

There are two artesian wells in South Australia, each flowing 1,200,000 gallons daily.

*3 days only.

New South Wales has a well, 1,729 feet deep, flowing 4,000,000 gallons daily, and another 1,638 feet deep with a flow of 2,000,000 gallons.

With the exception of the Dakota basin the artesian basin of Queensland, embracing an area of 376,832 square miles is the largest yet discovered in the world.

At Burrandilla, Queensland, two starting overflows were secured, one of 4,000,000 and the other of 2,500,000 gallons daily. No. 2 bore at Charlotte Plains, depth 1,848 feet, 4,000,000. Coreena bores, No. 2 and No. 5 respectively 1,500,000 and 1,000,000. Tinnenburra, seven bores, threw out 8,000,000 gallons of fine water daily. Boatman bore No. 1 discharges 4,200,000. It is estimated that at the present time 350 private bores in the colony of Queensland are flowing over one thousand million gallons of water daily.

FRESH MINING NEWS.

It is predicted that the production of gold this year in California, Washington, Oregon and Alaska will be a considerable increase over that of 1895 which was \$2,384,560 greater than in 1894.

Copper mining seems to be especially prosperous. Extensive additions are being made to the smelting plant of the United Verde Copper Company, at Jerome, Arizona, which is already one of the largest smelting plants in the country.

The Rothschilds have bought the remainder of the interest of the Hearst estate in the Anaconda mines of Montana. They bought 270,000 shares in the last purchase on a basis of \$45,000,000 for the property, yielding about \$7,000,000 to the estate.

The Engineering and Mining Journal has twice recently made reference to the extraordinary activity in the development of Utah mines. From all over the Territory old mines are being more extensively worked and new ones of great promise are being opened.

The Bennett placer machine is in successful operation on Green River, Utah, by the South Park Mining Company. The machine is run by electricity, and performs every detail of placer mining automatically,

from shoveling up the gravel to saving the gold on the plates.

The new furnace of the United Verde Copper Company, at Jerome, Arizona, the largest in the world has been put in blast. By a new process, originating with local parties, the ore is roasted and treated with the same facility and in the same time as is required for unroasted ore.

The general deficiency bill which was passed in the last days of the recent Congress makes provision for the assaying and sampling of lead and silver ores that are imported into this country, principally from Mexico and British Columbia. Sampling works are to be erected at El Paso, Texas, Northport, Washington, and Bonner's Ferry, Idaho.

A company is being formed to construct a cyanide process plant at Atlantic City to treat the ores of South Pass in Fremont county, Wyoming. It will have a capacity for the treatment of several hundred tons a day, of which there are large dumps to be worked at that place. They are obtaining as much now from the tailings as was obtained from the first working of the ore.

The Engineering and Mining Journal in a recent issue speaks of the mining activity in Utah, which has come about through a change from the old-time conditions, and the substitution of foresight for hindsight. The introduction of new processes of treatment and more careful prospecting, especially directed to the discovery of gold is leading to wonderful changes. The Park City, Tintic and Bingham districts go steadily on producing and paying dividends, but with very little excitement. New discoveries of low grade gold ores are reported from the Camp Floyd district, and it is being demonstrated that ore of very low average grade can be profitably worked. The Geyser mill report for April shows the average value of the ore milled was only \$3.92 per ton. The entire cost of mining and milling was but \$1.97 a ton, and the profit on this low grade rock was therefore \$1.95 a ton. A fifty-ton cyanide plant, therefore, yields the handsome return of about \$100 a day on less than \$4 ore, and it is not truly free milling. There is a good deal of ore in the district that is of much higher grade and pays well when shipped to the smelters.

BRIEF ITEMS OF INTEREST.

A salt factory at San Diego, California, is producing 1,600,000 pounds annually.

Wool prices all over the West opened about two cents lower than last year, with lesser demand.

The inhabitants of Colfax county, Nebraska, are hunting eels with guns. The sloughs are alive with them.

The United States produces 4,000,000 bushels of peanuts, or one-sixth of the total production of the world.

There are now more than a million miles of telegraph lines in existence and more than half of them in this country.

There were 45,000 tons of commercial fertilizers used in Indiana last year, of which 15,000 tons was raw ground bone.

A Tom Thumb calf is one of the curiosities at Hartford City, Ind. At two weeks old it weighed but twenty pounds.

It requires 40,000 electric lights for the houses of the English parliament, and fifty expert electricians to take care of them.

When water freezes it expands with a force estimated at 30,000 pounds per square inch, and no material has been found which can withstand this pressure.

It is estimated there are 400,000,000 fowls in the United States valued at \$200,000,000. The egg product of last year was 1,200,000,000 dozen, netting \$150,000,000.

In 1870 the farmers in this country formed 47 per cent. of the population. In 1880 it had dropped to 44 per cent. and in 1890 to 40 per cent. And even now it don't pay—nor any other business, for that matter.

One telegraph reporter sent out the press reports of the convention at which Lincoln was nominated. It required 200 operators to send the reports from St. Louis. The country is growing in more respects than in population.

Statistics by the Department of Agriculture at Washington show a decline in the value of farm animals of \$755,580,597 since 1893. The greatest depreciation is in the case of horses, in which the aggregate decline for seven years has amounted to \$500,000,000.

There have been 2,396 of Spurgeon's sermons printed and the total sales have reached nearly 100,000,000 copies, or an average of 35,000 copies each. There cannot be much doubt that he exerted some good influence on the world by his busy life.

Edward Atkinson makes the statement that the product of the hen in the United States is of greater value than all the iron products of the furnace; that it is twice the value of the wool, and three or four times the value of the products of the silver mines of the country.

Chas. S. Hawkins, in the Indiana Farmer, after four years' use of the corn shredder passes judgment against them as being too slow, making the fodder cost too much, and as too dangerous because of the frequent choking and the risks involved in clearing them. He thinks they must be improved or abandoned.

It is estimated that more than 3,000,000 dozen of eggs are broken by the Chicago grocers in handling, and that as many more are cracked and sold at a loss of from three cents to five cents per dozen, the total loss reaching pretty nearly a round half million of dollars. The two combined are about one-fifth of all that are sold in that market.

A GLANCE OVER THE FIELD.

ARIZONA.

Choice fat cattle are being shipped from the Salt River valley to Denver in considerable numbers.

Territorial bonds to the amount of \$350,000 have been disposed of in Chicago, and the turning of that amount loose in the Territory is expected to ease up the financial stringency.

Whitelaw Reid, it is claimed by the Arizona Gazette, has offered \$15,000 for the Churchill residence, with a view to making a permanent winter home in Phoenix. The offer was declined as too low, but it was thought he might raise his bid.

Governor Franklin has absolutely refused to carry out the provisions of a contract which was entered into by the lately removed Governor Hughes with an Eastern syndicate, for the employment of the prison labor of the Territory. The Phoenix

Courier says of it: "Under this contract the company gets everything, the Territory nothing," and ventures the assertion "that no such contract was ever made by any corporation from the dawn of civilization to the present day. Solitary and alone, it stands a monument to corporate greed and official rascality."

CALIFORNIA.

Fresno is developing rich oil resources, and has recently shipped its first car load.

Riverside people are agitating for the establishment of a shoe manufactory in that city.

The yield of the Edward Cooper olive groves, near Santa Barbara, is 40,000 bottles this year.

Judge Waymire has given notice to the directors of the Turlock district that work is soon to be resumed on the big dam.

The Hermosa Water Company has run its tunnel about 160 feet, and a new tunnel two miles further up the mountains has been begun.

The shortage of the deciduous fruit crops, owing to late frosts, ranges from 25 to 75 per cent., taking the State as a whole.

The Tulare and Kern irrigation district, at Delano, is to be disorganized. Almost all the residents of the district are in favor of it.

San Bernardino has been having its first water famine. It is not generally popular, and the people are inquiring as to who is responsible.

The raising of pampas plumes is growing into a considerable industry in the southern part of the State. The market for them is found in Europe.

A lively excitement has resulted from the discovery of oil prospects in the San Timoteo and Reche canyons. Many stock companies have been organized by Redlands people.

The hay crop in the San Jacinto valley will be unusually heavy this year, as nearly all the barley fields in the valley will be cut for hay. Only a very small per cent. is sufficiently heavy for grain.

The Citrograph predicts that many orange growers will abandon the fruit exchange system next year, as it has not met

expectations, and has not yielded so satisfactory results as have the sales f. o. b.

The California supply of olives, for which the demand has increased materially, falls short of the present consumption between \$3,000,000 and \$4,000,000 worth, without including the \$7,000,000 that was spent for imported olive oil.

Senator John Beard, of Alameda county, planted an acre in locust trees ten years ago. He sold last season all the trees measuring six inches in diameter for ship timber, making \$648 by the transaction, besides cutting thirty cords of wood for use.

One factory has been established in Los Angeles, said to be the only one in the State, for the manufacture of orange marmalade and it is proving decidedly successful. The "culls" are used, which have no value for shipping, and the article produced is of high quality and commands a ready sale.

Mr. Scott of Covina, has been foremost in demonstrating that lemon growing properly conducted is an industry of largest importance to this country; but it will not permit of slipshod methods. It is distinctly a scientific business, and those who will not study the requirements had better let it alone.

Mrs. Stanford has turned over to the trustees of Stanford University the amount of the Senator's bequest to the University. \$2,500,000. The amount was in railroad bonds, which pay a monthly interest of \$10,000. The balance required to run the University will be given by Mrs. Stanford from her private funds. The great ranches which were given to the University do not more than pay their running expenses.

The Southern California Railway Company has adopted a style of ticket which might be copied to advantage in other localities and for other purposes. With it tourists can take in all the points on their system, in fact, ride all through and around Southern California, in any direction, by any of the routes, and at any time to suit their convenience, within three months, coupons being good in every direction.

The Redlands Citrograph mentions that oranges throughout the county are dropping from the trees in greater quantity this

year than was ever known in that section. It is attributed to excessively warm weather followed by a cold wave which started the sap running and then suddenly checked it. Instead of getting the heaviest crop on record, as promised a few weeks ago, it is likely to fall considerably short of last season's crop. The quality of the remaining fruit is not injured.

The Co-operative Packers Association are slow to join the combination of packers which they have been trying to make effective. They claim to have benefited their stockholders who are growers, to the extent of \$5 per ton. They state this as their proposition: To pack goods at cost; to sell them at cost; to employ our own members as far as possible; to get all the market will pay, and pro-rate the amount received to each grower in proportion to that which he contributes, according to quantity and quality.

COLORADO.

The prospects for crops were never better in this State.

T. C. Henry expects to settle 200,000 acres of land in the San Luis valley, Arkansas valley and vicinity of Fort Morgan, by Scandinavian, Russian and other emigrants.

Denver florists are not only supplying their own home market, but the mountain towns of the State, and Wyoming, with cut flowers. Denver has built many greenhouses the past four or five years, and has completely taken the trade away from the Chicago and Omaha florists.

The Grand Junction News urges the necessity of a peach day celebration this year, in order to convince the public that the late frosts of the present spring did not kill all the fruit in the Grand valley. While there was some damage, they will probably have as much to ship out this year as last.

This State is promised by all odds the greatest tunnel on earth. The longest of the three tunnels under the Alps is less than ten miles, but this one, which is to start near Colorado City, is to be forty-eight miles long, with a branch line sixteen miles long, in the tunnel proper to Cripple Creek.

The Alfalfa Growers Association recently organized, has represented in its member-

ship 125,000 acres seeded to alfalfa, which yield an average total of 500,000 tons a year. Its value at \$5 a ton is \$2,500,000, and the Santa Fe road has established freight rates to Chicago, Kansas City and Galveston that will enable the grower to ship to these points and realize that price.

The farmers receiving water from the Handy ditch, near Loveland, one of the older ditches on the Thompson, having failed to get what they considered their proportion of the water, assembled in force, opened the headgates, in defiance of the county commissioners, and turned a full head of water through their ditch. They maintained their position for three or four days until their suffering crops had all the water needed. They evidently concluded it was better to stand a lawsuit than to lose their crops.

IDAHO.

The Reservation canal has been completed and the water turned in, near Idaho Falls.

From seven to ten car loads of settlers are to be brought into the Idaho Falls neighborhood from Iowa—so says the Register.

Floods in the Boise have done much damage in the neighborhood of Caldwell, washing away bridges and washing out considerable sections of the public roads.

KANSAS.

The little town of Pratt has decided to make no further effort to meet its bonded obligations, and will let the bondholders take the town.

A ten-foot Aermotor, and six-inch Stone pump have been purchased by the county and erected in the court-house square at Garden City to irrigate the lawns and park.

A forty-car corn train was started, with a great public demonstration, ex-Senator Ingalls being chief speaker, from Wichita, to attend the Republican Convention at St. Louis. It was five days en route and attracted great attention. It was a characteristic Kansas advertisement—in a good crop year. It ought to have been sent on to Kentucky and manufactured into whiskey. Then it would have been available to keep up the enthusiasm until after the election.

The fact that the average depth of irrigation wells in Kansas is seventy feet, instead of twenty to thirty, as many people suppose, is an indication that the upland settlers are making an endeavor to solve the problem of the plains.

The Garden City Imprint says the outlook for small grains in the county is very discouraging up to the middle of June. The prospect for good crops in the early season was better than usual, but the hopes of the farmers were dissipated by withering crops. There is no water in the river to fill the irrigating ditches, and a short crop of alfalfa is therefore threatened.

MONTANA.

This State leads the column this year in the number of sheep within its borders.

An electric power company with \$200,000 capital has been organized to construct a dam across the Missouri river about fourteen miles above Helena, to generate power to be used in and around Helena for mining, manufacturing and lighting purposes.

The Milk River valley is one of the finest in Montana, especially for the growing of grains, vegetables and hardy fruits. The soil is deep and fertile, there is an ample water supply and a good climate. The valley is being rapidly settled with a class of industrious farmers, and its resources developed.

The Montana College of Agriculture and Mechanic Arts is located in the wonderful Gallatin valley. Magnificent college buildings, to cost over \$75,000, are in course of construction, and an era was reached in the history of this great educational institution about the middle of June when it graduated its first students. Governor J. E. Richards was present and presented the diplomas to the four students honored as being the first graduates of the college, and also conferred upon each of them the degree of Bachelor of Science.

This college here means everything to the interests of the State and especially so to this valley, known as the "Egypt of America," on account of its wonderful fertility and the marvelous crops raised on its lands by means of that promoter of immensity of productiveness—irrigation. This college has an irrigation engineer,

and the fact that this country, once a barren waste, is now producing crops of barley, wheat and oats, the yield per acre exceeding that of almost any other section of the United States, and unexcelled in quality, is an omen of the importance of a professorship of this kind to the farming interests of this State. Irrigation is a science, and the acme of perfection is being realized with wonderful returns for every cent expended in irrigation in Montana.

NEBRASKA.

There is a promise of exceptionally good crops this year, and now the people are ready to cultivate the harvest excursions.

The McCook Tribune advocates sending a county exhibit to the Nebraska, Iowa and Illinois State fairs, for advertising purposes.

A Saline county farmer has 100 acres of popcorn planted this year. He has found it a profitable crop, which meets ready sale generally, in the Chicago market.

The "Irrigation Annual," published by the State Association, is a fine volume, filled with interesting information and well illustrated. It does credit to A. G. Wolfenbarger, of Lincoln, the President of the Association, who proposed it.

The State Engineer-Secretary of the Board of Irrigation has allowed the claim of the North Loup Company for water from the North Loup river in Valley county, sufficient to irrigate a thousand acres, conditioned upon the company applying the water usefully to the purposes of irrigation before September 1, 1899.

NEW MEXICO.

Work on the beet sugar factory at Eddy, in the Pecos Valley, is progressing rapidly.

Stock shipments from the northern part of Grant county have been the largest ever known.

The Western Homestead Irrigation Company is doing a big lot of work on the Rio Puerco. P. E. Harroun is the engineer in charge.

This Territory and Arizona are sending more fat cattle to market each week, and are furnishing more feeders for the northern ranges than any other portion of the United States. So says the Stock Grower.

The Deming Land and Water Company, beside paying off almost the entire floating debt, have taken up \$50,000 of their bonded debt in the past year by the sales of land to original bondholders. The demand for water is steadily increasing, and the company is in every way prosperous.

The recent floating of the Rio Grande Irrigation and Land Company in London is, when the real facts are known, hardly encouraging to American promotors of similar enterprises. Before the stock was offered to the public, nearly two-thirds of it was underwritten by parties, who, for a consideration in the shape of a share of the promotors' profits, guaranteed to take stock in case the public failed to subscribe, and, as the public did not respond very freely, the underwriters had to take up the shares. The concern was very extensively advertised and, if successful, will encourage investors in irrigation enterprises, but in the meantime it is pretty evident that irrigation securities are not looked upon with favor by the general public.

NORTH DAKOTA.

Water was struck on the Buttke farm in an artesian well that probably has the strongest water flow ever secured from a shallow well in the Northwest. The water burst the pipes far below the surface, gushing out for many feet around the original opening, heaping up immense quantities of sand and debris.

W. W. Barrett, the State Superintendent of Irrigation, is an earnest worker in behalf of the forestry interests. He is now advocating what he terms the Sylvan system, which provides for the planting of trees by the school children.

OKLAHOMA.

H. V. Hinckley of Topeka, Kansas, furnishes the following interesting statement:

In the report made to the Governor by the delegates to the Albuquerque Congress is found the following: (See bulletin 18 O. K. Ag. Ex. Sta. page 14.)

"Some statistics furnished us by the secretary of the Kansas Irrigation Commission will prove interesting in this connection. The average cost of different

kinds of power for elevating water for irrigation, as compiled by that commission, is as follows: Horse power, \$73.75; windmills, \$118.31; steam engines, \$283.12; gasoline engines \$486. *From these figures we may justly decide* in favor of the windmill as the proper power, although it is more expensive in first cost than the horse power, but it requires no attention after once in operation."

We trust that our Oklahoma readers will take these figures only for what they represent. The average cost of the pumping plants, with no data as to water lift or acreage irrigable, gives absolutely no idea of the relative merits of the various powers for any given case.

SOUTH DAKOTA.

More land is being put in shape by irrigating by artesian wells, windmills, etc., in this State than ever before.

The Huronite has been a long time agitating for good artesian wells at \$1,000 apiece, and it is now announced that they may be had for that throughout the Jim valley.

The Dakota Farmer protests against the waste of millions of acres of unused grass of a quality so rich and nutritious that no tame grasses can surpass, if they equal it. In the older States the meadows are the most profitable parts of the farm. The point seems to be well taken.

The business men of Chamberlain have agreed to give \$250 in cash, and also to get a list of four hundred cows from which the owners will guarantee to deliver the milk they produce to L. D. Beardsley of Mapleton, Minnesota, as an inducement to start a creamery.

Aurora county has forty-one artesian wells. Thirty-five are owned by farmers and used for irrigation and stock watering, the other six are owned by townships and cities and are used for stock and fire purposes. The wells range in size from two and a half to seven inches, and are from 475 to 1,000 feet deep, with a capacity of from 50 to 600 gallons per minute.

The Milwaukee road has an irrigated farm near Mellette. Nearly 400 acres will be under water. Twenty acres are devoted to experiments for the testing of seeds, grasses, vegetables and trees.

There are also of farm crops, potatoes, 220 acres; oats, 200 acres; wheat, 160 acres; millet, 40 acres; corn, 40 acres; barley, 100 acres. The Salzer Seed Company is also conducting experiments there. The Mellette Tribune is especially an immigration organ. Last year the Milwaukee road adopted a policy of running excursions to the farm, which they will continue this year.

UTAH.

Active development work of the coal mines has been begun in the neighborhood of Provo.

The advantages of spraying have been so apparent in this State that the legislature provided for county and State inspection, and makes it obligatory upon all fruit growers.

The first sale of State bonds to the amount of \$200,000 has just been effected, Edward H. Jones & Co., of New York City, being the purchasers. They paid a premium of \$8,000 on 4 per cent bonds, indicating the high credit of the new State.

The Millard Progress reports that cold weather and heavy snows have proved disastrous to nearly all the flocks in the leading sheep districts of the State, causing a loss of ewes and sheared sheep to the amount of many thousands of dollars.

The big reservoir in Three-Mile canyon, south of Hyrum City, burst its banks on June 7, and a solid wall of water, sixteen feet high, carried destruction before it for a distance of thirty miles through the valley. Fields were covered one to four feet deep with sand, trees and boulders.

The machinery of the Big Cottonwood Power Company has been set in motion, generating 3,000 horse-power, which is to be transmitted to Salt Lake City, and to several mining camps. Under the direction of R. M. Jones this great work has been brought to a successful completion under difficulties which few would care to encounter.

Under the new law it is provided that before April 15 of each year every orchard and vineyard and every single tree grown on a lot or parcel of land, shall be thoroughly cleaned of all dead leaves and other debris, which shall be destroyed

by fire. The ground must be kept clean of anything that is likely to breed disease or insects.

A snow slide into Morgan lake, above Park City, forced the waters out of its banks, and for a time it was feared that much damage would result to mining property. When the flood had passed, the road was found to be gullied to the depth of five or six feet, but the damage was promptly repaired, and there was no occasion to suspend work at the mills and mines.

The accomplishments through co-operation are well illustrated in the little city of Midway. The people joined in an expenditure of about \$10,000 for the construction of water works. The cost was only about \$20 to each family aside from the work they contributed, and every family shares in the use of the water. Nowhere has co-operation had more practical illustrations than in Utah.

Inquiry has been made from London capitalists as to the terms for power in Salt Lake City for an establishment that will employ 2,000 workingmen. The Tribune well says: "There should be a dozen great manufactories established in this valley; great chemical works, great glass works, great iron and steel works, and other works to convert the rare crude materials found in such variety and abundance in this region into commercial forms."

WASHINGTON.

The Yakima Herald deploras the action of people in its community who have instigated injunction proceedings to stop work on the Reservation irrigation canal.

Irrigation has made a wonderful change in Yakima county. The introduction of alfalfa and its utilization for stock feeding, and the incidental growth of the cattle and sheep industry, is substituting the hop raising industry.

Creameries are becoming common in all parts of the State, but Kittitas which was among the first to establish them, claims to be well in the lead, having gained the experience which puts them on a safe footing with success achieved.

Spokane men have purchased Sylvan Lake, in Lincoln county and will make it

a game and fish preserve. It is noted as a rendezvous for ducks and every encouragement will be offered to induce the ducks to make their homes there. The lake is also to be stocked with black bass, although it is well supplied already with finetrou. A club-house is to be erected and every convenience will be provided where true sportsmen may enjoy the pleasure of trying their skill as a marksman without killing game at wholesale.

Up to the present time all local reports go to show that the grain crop prospects are the best in the history of Eastern Washington. There has been, thus far this season, much more rain than usual. The latter part of April, the month of May and the forepart of June, gentle showers have taken place nearly every other day contributing largely to the above condition of the crop prospects.

The stockmen have about completed their roundups, and they report that the ranges are the best and the stock looking the finest for this season of the year in the history of the business. Buyers are now on hand and prime fat beeves are being shipped to market at very fair prices.

Fruit prospects now are that the apple crop will be the largest and most valuable ever known. The season for berries and small fruits is from ten days to two weeks behind the average on account of the lateness of the spring, and will be somewhat under the average in quantity on account of the late frost in the majority of the fruit growing localities; yet quite a large amount of small fruit of very fine quality is being shipped to market. Pear and prunes will be below an average crop. This favorable weather continued will insure a harvest of a very fine quality.

While the Western and South-western States along the Mississippi valley from Minnesota to Texas are being swept with terrible destructive freshets and cyclones, destroying hundreds of lives and millions of dollars of property, Eastern Washington which has never experienced anything of this kind, is enjoying an ideal climate favorable for health and comfort, and a most luxurious vegetable growth insuring ample return to the cultivator of the soil.

WYOMING.

The Fetterman canal, near Douglas, has been completed, and is in operation.

There has been more ditch building in the Big Horn country this year than in any previous year.

The ranchmen of Ranchester are about constructing an immense reservoir for irrigation purposes.

In a case carried to the United States Supreme Court from this State, it has been decided that the Indians must submit to the State laws as to hunting on the public lands, except within the designated hunting districts.

Secretary Smith has directed the Commissioner of the General Land Office to make contracts for the survey of thirty-nine townships in this State, in order that the State may make selections of school land, as provided by the act of admission.

State Engineer Meade assures the managers of the Trans-Mississippi Exposition, to be held in Omaha in 1898, that Wyoming will improve the splendid opportunity it will offer, to make a comprehensive exhibit of the resources of the State.

A pipe line twenty-one miles long is to be constructed for mining purposes on the Sweetwater, application having been filed with the State engineer. It is proposed to mine a tract embracing nearly 6,000 acres. The pipe is to be three feet in diameter, and the cost of the work is estimated at \$225,000.

A section of land ten miles square, in one corner of the Shoshone and Arapahoe Indian reservation, has been purchased by the government, and will be converted into a reserve and held as a National Park. It includes the famous Hot Springs, at the head of the Big Horn river. These springs are noted for the cure of rheumatism. Although the mountains were still full of snow, Inspector McLaughlin, who negotiated the purchase, found twenty-five white men there, all invalids, who had been carried through the mountains on cots, but were all walking about when he was there.

AMONG THE PAPERS.

In these days the genius and perceptive faculty of man is making such marvelous use of the powers and resources of nature that everybody is interested in following the developments. A monthly publication, "New Ideas," keeps close

tab on everything of public interest, either in the way of new inventions or improvements on old ones. It is published monthly at Philadelphia.

The "Practical Farmer," of Philadelphia, occupies a unique position among the agricultural press. It submits all sorts of practical farm questions to those most experienced in the specialties, and publishes answers of inestimable value to its readers. The weekly letters of T. B. Terry are of themselves a feature which ought to give the paper a hundred thousand subscribers.

"Practical Irrigation and Fruit Growing" is the title of a new paper just started at Roswell, N. M. As its name indicates, it is to deal with practical questions, and it should be of great benefit to irrigators, especially those in the Pecos valley where it is published. *THE AGE* is always glad to welcome new papers relating to irrigation, a journalistic field which *THE AGE* created.

"Greater Texas" is the name of a new publication which comes to our table, which shows rather extraordinary editorial ability. Its comprehensive grasp of the practical questions, upon the solution of which the future growth of that great State—immense in area and equally so in resources—and its admirable discussion of them, cannot fail to make it a power for good. It shows excellent judgment in its appreciation of irrigation as one of the leading factors in the development of its latent wealth, and its advice may well be heeded. Texas has at length succeeded in securing from the general government its assistance to improve the harbors of the gulf coast, and three of them are already open to the larger class of merchant ships. With its favorable climate, rich soils and accessibility to ocean transportation, it will start in the race with the interior agricultural States with many substantial advantages.

BOOKS AND MAGAZINES.

Artesian Wells as a means of water supply. By Walter Gibbons Cox C. E. Published by Capsford & Co. Brisbane, Australia, American Agents, Van Nostrand Company of New York. Price \$3.00.

This book written by a prominent engineer of Australia is filled with information of great importance to those interested in irrigation. It gives the history of arte-

sian water supply from ancient Biblical times to the present, including the experiments and results of boring in America, Europe, Africa and Australia. Naturally, the chapters relating to Australia are more numerous than those of other countries. The geological conditions affecting the flow of artesian water, analysis of water, temperature, effects on climate are all ably treated. The author has used good judgment and care in selecting material and he has handled the subject in a thorough, practical manner. The volume should be in the hands of all irrigation engineers.

C. STIRLING, M.D.

WONDERLAND 1896.

By Olin D. Wheeler. Northern Pacific Railroad. Chas. S. Fee, General Passenger Agent, St. Paul. Six cents in stamps.

The 1896 edition of "Wonderland" issued by the Northern Pacific Railroad is beyond comparison the most interesting of tourist publications. Beginning with a description of the transcontinental train, as it waits in the depot at St. Paul before starting on its long western journey, it closes with valuable information about far-away Alaska. From first to last it is filled with graphic word painting of the grand, inspiring and beautiful scenery from Minnesota to the Pacific Coast and it is illustrated in a most luxurious manner. The pictures and description of scenes in the Yellowstone National Park are especially worthy of attention, and tourists and sportsmen will be particularly interested in the accounts of exploring and hunting trips indulged in by the author, Mr. Olin D. Wheeler. It has become a confirmed habit with the passenger department of the Northern Pacific Railroad to issue annually a new "Wonderland" book and with each succeeding issue the work becomes more and more interesting, and this year's number with its startling cover in black and red is worth many times the six cents in postage for which a copy will be sent to any address by Mr. Chas. S. Fee, General Passenger Agent, St. Paul, Minn.

American Newspaper Annual for 1896. N. W. Ayer & Son, Philadelphia, Pa.

This is one of the best and most reliable newspaper directories issued and the present edition lists the enormous total of 21,225 publications including the United

States and Canada. In the State of New York alone there are 187 daily newspapers; 1,151 weeklies and a total of 1,949 for all kinds of publications. In Pennsylvania there are 197 dailies and 972 weeklies, with 1,446 as total number of publications. The following table of publications shows that the Western States and Territories are not unprovided with reading matter:

Place.	Daily.	Weekly.	Total, all kinds
Illinois.....	156	1,210	1,660
Texas.....	67	636	751
Kansas.....	49	619	715
Nebraska.....	29	570	649
California.....	102	458	647
Colorado.....	35	226	290
S. Dakota.....	21	231	272
Washington.....	17	194	230
Oregon.....	18	149	193
N. Dakota.....	9	124	139
Oklahoma.....	8	112	129
Montana.....	12	79	100
Utah.....	10	44	68
Idaho.....	4	57	66
N. Mexico.....	5	47	57
Wyoming.....	5	36	42
Arizona.....	9	29	38
Nevada.....	9	15	26
..	565	4,836	6,077

The appointment of W. T. Hornaday as superintendent of the proposed Zoological Garden in New York lends interest to the article in the July Scribner's, by J. Carter Beard, the animal painter, on taxidermy, which he calls "A New Art." He describes Mr. Hornaday's work as showing the best existing specimens of the art.

Rudyard Kipling, as he showed himself to his intimate friends just before he became known to all the world, will be the subject of a paper in McClure's Magazine for July. It is written by the man with whom Mr. Kipling was associated in the editorship of a newspaper in India, and it will be illustrated with portraits and other pictures from photographs furnished by Mr. Kipling's family.

Professor Peabody, of Harvard, who is a member of a committee, consisting of President Eliot, President Walker, President Low, Charles Dudley Warner, and others, for the investigation of the drink habit in Boston, and of the different substitutes for saloons that have been established there, sets forth in the July number of "The Forum" some of the results of this important investigation.

THE AGE AS A DIRECTORY.

Read the advertising pages of THE IRRIGATION AGE carefully. They contain announcements and information which may be of great value to you. Our advertising department constitutes a directory of a great variety of machinery, implements, tools, and appliances for irrigation and farming purposes, as well as the names of engineers, lawyers and others who make irrigation a specialty, and moreover these advertisements are inserted by companies, firms and individuals whom we know to be reliable. If you don't find what you require, write us and we will be pleased to place you in communication with some responsible party who can supply your wants. We especially request all our readers to state that they saw the advertisement in THE IRRIGATION AGE when writing to advertisers. This will insure prompt attention to your letter, and will also show the advertiser that it pays him to patronize our columns, a point that is quite as important to us as to the advertiser.

WRITE FOR INFORMATION.

Don't hesitate to write THE IRRIGATION AGE whenever you desire information. If we can't give it to you immediately, we get it as soon as possible, and it won't cost you anything.

ALMOST OVERPOWERED.

A wild-eyed man, with his mouth out of joint, was found leaning against a lamp post on Fulton street.

"What's the matter with him?" yelled the crowd, as it ran up.

"Give him air," replied the policeman; "he's a stranger, and he tried to say Tchoupitoulas street."—*New Orleans Times-Democrat.*

ONLY FIFTY CENTS.

Fifty cents pays for THE IRRIGATION AGE for the balance of the year. This comprises Vol. X complete. Every subscriber who sends us five of these trial subscriptions will have his own subscription extended for one year from the date of its expiration. Every subscriber who sends us ten of these trial subscriptions may retain two dollars in cash.

We Want Silver

and will furnish you cards for sending fifty cent pieces by mail safely.

TOPICS OF THE TIME

Irrigation in the East. Gradually it is dawning on the farmers of the older States that the benefits of

irrigation need not be confined to the plains of the West. There are few farms in the eastern States that are not "well watered," and every such farm may have its product increased and insured by a comparatively small expenditure, mostly in labor, by conducting the water from a running stream or from an artificial reservoir, which may be cheaply constructed. A farmer in New York recently stated that he had never known a year when there was rainfall enough to produce one full crop. A few plow furrows supplemented by the use of a common scraper will carry the water along the hillsides into the main laterals for the fields to be watered. Lay out the rows so that water will run between them, not too rapidly, and turn it in when it is needed. There is almost always a week or two during the growth of a crop when a little additional water would add largely to the product. It should be remembered, too, that the preparation for irrigating will provide for carrying off surplus water as well, a matter of hardly less importance. Every farmer ought to, and every progressive farmer will, read up on irrigation and its benefits. It will pay.

Adjustment Necessary. American farmers, by their prompt adoption of improved machinery and methods, are producing so much of the general products of the farm as to compel a dependence on foreign markets for the disposal of the surplus. In those markets they are meeting competition from countries where cheap labor and the silver standard enable the production of this class of products at a price which will not afford our farmers any such profits as they have formerly enjoyed. So long as we offer our surplus on the European markets, the price for our entire product will be fixed by the price at which we must sell the surplus. The only practical remedy is to reduce our production in those leading crops to the home consumption, or else to so stimulate the

home consumption as to make a market for all that we do or may produce. If, for instance, a portion of the land devoted to wheat should be turned to sugar producing, there is room for the substitution of nearly \$150,000,000 of sugar that is annually imported. A similar substitution may be made as to many other products which we now import largely, but which might be produced at home. The curtailing in one line and expansion in others would seem to be the sensible thing for our farmers to consider.

Industrial Paradoxes. Bursting granaries and starving tramps, low-priced corn and hay and neglected animals, full crops and widespread destitution, unequalled manufacturing facilities and restricted consumption, a wonderful progress in invention and inability to profit by it, stockholders of corporations getting richer and their employes getting poorer. These are existing conditions that none can dispute. There are reasons for it, and there are remedies. Where are the statesmen who can grasp and change the situation?

Controlling the Floods. When the river and harbor bill was under discussion in the senate, on motion of Senator Warren of Wyoming, an amendment was adopted providing that engineers of the war department shall make examinations in Wyoming, Utah and Colorado, and report to Congress whether it is practicable and desirable to impound the rivulets and streams of the mountains in reservoirs, and thereby prevent the erosion of the banks of the great rivers of the Mississippi valley and prevent damage from floods, the water to be used for irrigation of lands now arid. The word irrigation had to be eliminated as not germane to the purpose of the bill, but with that left out the amendment was adopted. It matters little how such an examination is accomplished. It can hardly be done intelligently without showing the vast benefits to flow from the holding of the storm waters for the double

purpose of watering the choice plain lands and maintaining a steady and uniform flow in the lower Mississippi and the Missouri rivers.

A Wedge Inserted. An amendment by Senator Warren to the River and Harbor bill, providing for an appropriation in the interest of irrigation development is a new departure, and all the interior States of the West are directly interested in it. Heretofore such appropriations have been almost wholly confined to the ocean coasts and large rivers. The amendment in question provides that surveys shall be made with a view to impounding the head waters of the large rivers, with the double purpose to prevent floods in the lower rivers, and to provide for irrigation in the valleys below the reservoirs.

Pestiferous Reformers. Professor Bailey, of Cornell University, makes some strong points in an address which he delivered before the Michigan State Horticultural Society. He claims that but for the pests which we must eradicate to save the crops there would have been slower progress in improving methods of culture, and there would be less stimulation for the cultivation which is necessary to secure the best results. He cites the influence of the potato bug, the Canada thistle, peach yellows, etc., which at one time and another have threatened the destruction of great industries, as productive of pronounced improvements in the treatment of land and plants, and as enforcing the necessity for careful selection of varieties and an exhaustive study of the conditions which surround them. He finds ground for hope that the apple scab will revolutionize apple culture in the East and that the Russian thistle which has made its appearance in some of the Eastern States will also wake the farmers up to deeper thought and more vigorous action.

Western Enterprise. It is a great piece of work that is being done in the Ogden canyon, Utah, it being only second in magnitude to the great power plant at Niagara. A body of water, as large as can be carried through a pipe six feet in diameter, is delivered under a head of 560 feet and under a pressure of 200 pounds to the square inch. The lower portion of the immense pipe is made of $\frac{1}{4}$ inch sheet

steel, which is shipped there from the rolling mills in sheets eighteen feet long and nine feet wide. A well-equipped machine shop for the manufacture of the pipe has been constructed, having bending rolls, punching machines and riveting machines of the most approved patterns, of immense power. There will be a mile of the steel pipe and five miles of wooden pipe of the same diameter, for which 200 car loads of Oregon pine will be used in making the staves. Ten thousand horse-power will be made available by this construction. The men who conceived and have carried this work forward with such effect that they can announce its completion by October of the present year, and in times like these, will hardly be denied credit for courage, boldness and enterprise. Senator Frank J. Cannon is president of the company.

Wasted Water. Professor Boggs, of the Arizona Experimental Station, calls the attention of irrigators to the great loss of water which results from the use of an excessive number of small laterals. The waste from both evaporation and seepage in such a climate as that of Arizona, or, for that matter, in any of the arid States, is a very large proportion of the total supply, when it is carried for long distances. Where water is scarce it is worth while to consider carefully the location of such ditches so as to limit the number of them, and wherever at all practicable such ditches should be substituted by pipes, or be lined with stone and cement. It is not good business judgment to expend large sums for the conservation of a water supply and for the lack of a little further expenditure permit the loss of a half, or more of it.

Wisconsin Irrigation. The Wisconsin Experiment Station made some tests of supplementary irrigation last year which fully confirmed the good results obtained by Dr. Gapen in Illinois. The yield of corn was increased over 300 per cent, as compared with a non-irrigated crop alongside. Three and a half acres of clover were irrigated at a total cost of \$18, with a net gain of five and a half tons of hay, and thirty-one days' pasture for fifty-eight sheep. The time is not very far distant when farmers generally, in all States, will

see the advantage of providing for irrigation, so far as their situation will make it possible, as a protection against temporary drouths. It is decidedly the cheapest policy of crop insurance.

New Route To Europe Not less than three of the Texas gulf ports have been so improved as to admit vessels of deep draft to their wharves. Railways to each of them have direct connection with all the Western States, and the farmers west of the Missouri are anticipating favorable results to flow from this opening for new lines of commerce. It is being demonstrated as entirely practicable to ship corn via the gulf to Europe, and it is likely to create an active competition between the roads running east and those to the south, and all to the advantage of the western farmer. Beef, too, that sells for four cents a pound in Kansas City is worth eleven cents in Liverpool, and one of the live questions now among all those interested in stock raising is whether they cannot secure a portion of the difference between four and eleven, by shipping via the gulf ports.

Look Ahead. It is estimated that within three years, possibly within two, there will be a million bearing orange trees in the Riverside, and two-thirds as many in the Redlands orchards. This is but one-third the total in Southern California, and as the average product is fully two boxes to the tree, this will mean ten million boxes, or more than 30,000 cars of this fruit to be marketed. The marketing period is from December 1 to June 1, six months, and it will involve the shipment of five thousand cars a month during that time. It follows that the present market area must be greatly widened, or that the consumption in the districts already covered must be greatly increased. Such increase is only possible by a lowering of the price to consumers, and as the growers cannot well accept much lower than the usual price, the improvement must come through the cheapening of the transportation or packing and selling charges. There is none too much time to prepare for it.

Delayed Emigration. It has been the general rule that after a period of commercial and financial depression there has been a pronounced movement of the people to the newer States. That movement, which has been long expected, does not ap-

pear to materialize, perhaps because we have not reached the turning point. The depression seems to be still on hand. Those who are willing and ready to move, can't, for the lack of means to move with. They cannot sell present holdings.

Nebraska Enterprise. The Nebraska Club is organizing a Home Newspaper Correspondence Bureau and solicits a thousand writers throughout the State who will send at least one letter a month to their "old-home" papers in the East. Outline letters will be furnished by the club so that there is little work required, except to fill in the blank spaces and add a few items of local news—to pull the wool over the eyes of the editor. They modestly expect to reach five million eastern readers and to advertise the attractive features of the State at a nominal cost. Nebraska people may lack in some things; evidently assurance is not one of them.

Lifting Mortgages. The farmers of Lincoln county, Washington found themselves under a load of mortgages which they could not lift from the product of their farms. They quit the farms and went prospecting in the mountains, found mineral, opened and worked the prospects, made mines of them and paid off the indebtedness due on the lands. They are fortunate in living in proximity to gold mines where such a course is practicable, but it is a suggestion of intimate relation which will sometimes exist between the agricultural and mining industries of the mountain States. If the mines had been developed by others it would have made a market for the products of the farm, so that each would have performed his legitimate share, the miner and the farmer.

Wisconsin Institutes. J. L. Shawver writes to the Grange Bulletin a very interesting communication with reference to the growth and success of institute work in the Badger State. There were one hundred and five institutes held there during the past year, all under the superintendence of Hon. George McKerrow and conducted by an able corps of five conductors, with assistants, two or three specialists and volunteer local talent. The influence is plainly apparent in improved culture, and farmers everywhere are taking the lively interest which indicates better than anything the real value to them.

MACHINERY AND APPLIANCES

THE CONTRACTOR'S DUMP WAGON.

The Contractor's Dump Wagon, recently put on the market by the F. C. Austin Manufacturing Company of Chicago, and illustrated above, is something that contractors will appreciate, and the reputation of the manufacturers is a guarantee that the wagon will be well made.

A serious difficulty with all "bottom-dump" dump wagons previously constructed has been that the doors being hinged, and therefore laterally rigid, frequently stall the team on the dump. When it is understood that all dumps, whether of earth, rock or garbage, are very uneven, and that one or more of the wheels, when the load is being dumped, rests in a pocket or low place, the objection to the hinge doors will be apparent; for example, should the hinge door strike a load previously dumped, or any obstruction before the load is fully discharged, it is necessary to move in some other direction to release the door, which, as will be understood, cannot be done without heavy pulling and a strain on the team; again, with one of the front wheels in a low place, the front end of the hinge door is likely to run into a previously dumped load or obstruction, which stops the team, as well as wrenches the box, tearing off the hinge door.

The doors of the Contractor's Dump Wagon, illustrated above, when closed, make a comparatively tight bottom; when open, they can oscillate in any direction, thereby adjusting themselves to the debris or obstruction underneath.



INCREASING USE OF WINDMILLS.

The fact that an Aermotor has just been purchased by the authorities of Garden City, Kansas, where all styles and varieties of windmills are in operation, goes to show that they consider the Aermotor the best manufactured, and fully able to stand the severe work required in raising water for irrigation. For this purpose a strong well-built mill is needed, as the work is very heavy, much more so than any task to which the windmill has heretofore been harnessed, and the past few years have demonstrated that the Aermotor is able to meet the requirements. It is increasing in popularity constantly, and in spite of the prevailing hard times, new factories and a larger force of workmen are needed to meet the demand. Arrangements are now being made to add another six-story building to the plant.

The Aermotor Company of Chicago is fully alive to the importance of irrigation, and has issued a special catalogue on this subject, which will be mailed to any address free, provided THE IRRIGATION AGE is mentioned when writing for it.

A USEFUL INSTRUMENT.

The Jackson Grade Level Company has recently made a very important improvement in their level by adding a horizontal circle, which is attached permanently to the shoulder of the tripod head. This is graduated into degrees, and a pointer is attached to the level above, thus enabling any one to run accurate lines straight or at any angle without the trouble of measurements.

Supt. W. F. Cash, of the Experiment Station, Idaho Falls, writes of this level as follows: "I have an instrument with which I can turn off a right or other angle, and find it very convenient in laying out irrigating ditches, where a series of small ditches take off from the main ditch. It is also very handy for laying off land for plowing, setting fences, etc. The new improvement adds greatly to the usefulness of the level, especially in an irrigated country."



LAKE WINNEBAĞO BY MOONLIGHT.
[On the line of the Wisconsin Central.]

THE IRRIGATION AGE.

VOL. X.

CHICAGO, AUGUST, 1896.

NO. 2.

THE PROGRESS OF WESTERN AMERICA.

Halting Industry. Whatever the conditions in other sections of the country, and no one will pretend that they are satisfactory anywhere between the Atlantic and Pacific coasts, there is no disputing the fact that the growth of irrigation in the western half as a prominent industry, which was so rapid from 1887 to 1892, has been materially checked and in many instances disastrously so. Before the close of 1892 capital had begun to flow freely in this direction, where it gave promise of exceptional returns for investment. Since that time not only have no new investments been undertaken, but many of the greater works which were unfinished have been left in such a state as to involve heavy loss and to preclude any possible profit from the amounts already expended. The causes for this are not all direct; indeed it can hardly be claimed that any of them are direct, for not only does the industry fulfill as to all finished works all that has been promised for it, but it is more than holding its own, relatively speaking, with every other productive industry of the country. While it assists and increases the products of agriculture and horticulture it shares with all other industries the loss from low prices and the depression incident.

Migration Suspended. However complete the facilities that have been or may be provided for the irrigation of lands, they are of no more value than before, until they are occupied and put in cultivation, and for the large plants where immense areas are furnished with a water supply the first essential is a prompt occupancy of the lands to be reclaimed. The

investment contemplates the utilization of every acre and can hardly be profitable without it. Charges must be fixed upon that basis and until such time as full settlement is effected the works, save under very exceptional conditions, must be run at a loss to the investors. While there is some movement toward cheap lands by people who have no present property holdings and who are therefore footloose and independent, it is not of a class such as is imperatively necessary for the improvement of irrigated lands. A man must have some capital, even though it be only a few hundred dollars, for he has to deal from the outset with comparatively high-priced lands and he must not permit any of his lands to lie idle, as all are necessarily subject to the maintenance charges of the canal system. This class of men, almost universally have investments, either in homes, lands, stock and personal property which must be turned into money before they can leave their present location. In no part of the country is it now possible to dispose of such holdings without sacrificing a considerable part of the original cost, and the practical difficulties are so great as to prevent many transfers.

Causes of Depression. These are variously attributed and very complex. If there was no difficulty in diagnosing the case it would be an easy matter to find a remedy. There can be no such effect without a cause, nor can it be so widespread and universal without a deeply-seated, underlying reason that is not temporary in its operations and influence. It is an insidious, cancerous growth, difficult to understand or to account for satisfac-

torily. The entire country is suffering and almost all classes of people, and that suffering is becoming so intense that it has become the paramount public question, demanding the attention of the governmental administrations, both national and state. Old party lines are being obliterated and new ones are being formed in the effort to solve the great problem and to restore the national prosperity. One of the two great parties has declared in its platform that the tariff is accountable for it all, while the other attributes the steadily augmenting troubles to the demonetization of silver. There are many dissenters in both of the parties, but so generally has the latter belief been promulgated, that the republicans, who were a few months ago confident of an easy victory in the coming elections, are now compelled to strain every nerve and utilize every resource of money and influence at their command to hold their own against the growing sentiment. All of the minor party organizations, representing the dissatisfaction with some present political conditions, prohibitionists, silver nationalists, populists, or a majority of each, are joining with the democrats to bring about a restoration of silver coinage, and the contest promises to be one of great bitterness and intensity.

Paramount Necessity.

THE IRRIGATION AGE has confined itself rigidly in the past to the promotion of the single interest which it so distinctively represents, but now an economic question which directly involves the future of this industry has become a leading political question of such magnitude as to compel new party alignments and upon its proper solution a very great deal will depend. Its readers cannot fail to be interested, for it is distinctively the concern of the agricultural and laboring classes, who are the greatest sufferers from the present conditions. It is essentially a question where self interest, selfishness if you will, will be a controlling factor. Those who are favored under existing systems will strive to maintain their advantage regardless of philanthropic considerations. All business is largely conducted on the basis of self interest, and who fails to recognize it can hardly expect to succeed in his undertakings. We expect the banker to look

after his own interest, and he must recognize the right of the farmer to do the same. Where there is conflict as between the several classes, republican government contemplates the protection of the weaker elements with justice to all, and public sentiment as well as public necessity finds expression through the ballot box in the selection of representatives pledged to carry out in the legislative halls certain defined policies.

Political Situation. The discussion in these columns will be with reference to principles rather than candidates. The nominees are both strong men; both are clean men morally and intellectually; both are of Scotch-Irish descent, and are singularly alike in many traits of character; both are intensely earnest men and sincere in their devotion to the principles they enunciate; both are eloquent, and both are indebted to that eloquence for the prominence they have now attained; both are of a domestic nature, and both are happily mated with true and helpful wives; both are patriots and commoners, having close touch with the masses; both are men of experienced judgment, although one is much younger than the other; both have a congressional experience, and both were recognized for their ability as legislators; both are broad-minded western men, and recognize that nation with a capital N; either will uphold the honor attaching to the presidency of the greatest republic on earth. It is, therefore, a question of economic principles which the people are to pass upon, and there is every indication that the campaign is to be distinctively an educational one with every voter a seeker after the truth. The platform and the printing-press, the schoolhouse and the street corner will all have a part in the discussion which is about to begin. Business will have to wait upon the exigencies of politics.

Tariff Secondary. The first public appreciation of the depressing influences which were gathering head so quickly followed the last change in administration, it is no wonder it created confusion in the minds of the people. The tariff had been the issue on which the campaign had been fought, and the free traders had won. No matter what the



SENATOR FRANCIS E. WARREN,
of Wyoming, Chairman Arid Lands Committee, U. S.
Senate.

real cause, the winning party was naturally held responsible for the results which so promptly followed. Yet it is the plain truth that the free trade policy was never put in operation, except as to a few articles, and that the substitute legislation for the McKinley bill provided for a tariff quite as high and equally protective as to many important industries. The public clamor has been so loud that even the democrats themselves have tired of it, and while the republicans have sought to make capital out of the question they have been careful to assert that only such changes will be made, in event of their success in the coming election, as may be necessary to provide for a sufficient revenue to meet the requirements of the government. There is only the difference as between tweedledum and tweedledee in the two platforms this year. The republicans demand a protective tariff to produce sufficient revenue; the democrats favor a tariff that will provide sufficient revenue and that will incidentally afford an equal protection to all industries. They are willing to drop the subject and say no more about it, for every intelligent man is fairly convinced that free trade is not best for this nation under existing conditions.

Silver Coinage. Financial questions came to the front before the president-elect could take his seat, and the first notable act of President Cleveland was the calling of a special session to consider the repeal of the Sherman silver coinage law. It was asserted and insisted that only that was necessary to turn the tide of disaster. But the tide did not turn, and is still at ebb. Industry is half paralyzed; the common people are living on past accumulations, and are compelled to a practice of economy that is a hardship to an American of any degree; great crops are almost valueless to the producers, the income from them being barely sufficient to support life and affording no margin for expenditures which had made this the greatest home market ever known. The payment of old debts has been suspended, and even the current obligations can not be met. It is said that the implement dealers alone are carrying more than sixty millions of past due paper. There is no intent to repudiate or avoid its payment, but the crops they raise will not bring them money enough to pay it with. Constituting about one-half the population of our country, such a condition for our farmers cannot fail to have a blighting effect on dependent industries. Right here is where the trouble begins. The farmer cannot prosper with wheat at 35 cents a bushel, oats at 5 to 10 cents, potatoes at 10 to 20 cents, and everything else in proportion. He can live with but little in addition to his own products, but he can neither enjoy the comforts and luxuries to which he has become accustomed, nor can he accumulate property.

Cause of Low Prices. Reference is here made particularly to the prices of farm products. Let us see how they are fixed and where. Western Europe and Great Britain is the chief consuming market for food supplies and raw materials. Manufacturing in all its branches is the most important industry, employing most labor and capital. Their agricultural productions, though large in the aggregate, do not supply the home markets. Here, then, is the dumping ground of the surplus products of all other countries. That country which can sell the cheapest sets the price at which all others must sell of any particular commodity.

To illustrate, we will take wheat, which is a production common to many countries. Naturally Great Britain will favor its own colonies, and the commercial and financial supremacy of that kingdom gives it a commanding influence as to all its neighbor markets. When silver was demonetized twenty-three years ago, the chief competitor to the United States in supplying Europe with wheat was India, and a bushel of wheat was about equivalent in value to an ounce of silver. These two countries have continued to compete in the same markets, but under distinctly different conditions. They were on a silver basis then and they are yet; that is, their products were and are measured by a silver standard. This country had a bimetallic standard then and silver and gold were at a practical parity, and as there was free coinage of both metals the commercial and coinage ratio were the same. Through some influence which it is difficult to exactly locate our congress was induced to demonetize silver, to make a commodity of silver bullion, which being denied coinage fell rapidly in price relative to gold which became practically the single standard.

Coincident Decline. It was then that trouble began for us. It was not realized until we had begun to prepare for a resumption of specie payments, and then the fall in price was interrupted and retarded by the Bland-Allison act, which provided for the purchase and coinage of \$2,000,000 to \$4,000,000 of silver bullion monthly. There was a sufficient excess over the purchase limit, as fixed in that law, to meet all the requirements of Europe in keeping up the waste of its coin in circulation, and to settle Asiatic balances, and the price was pretty well sustained for a number of years, but at a discount of 20 to 30 per cent. Then the production of silver began to increase in this country and the surplus for export was greater. With mints of all the leading nations closed against it, with all the financial institutions of Europe and this country leagued in opposition to its free circulation, and with the ruling of our own treasury officials to still further discredit it, the price began to fall again. Then came the Sherman bill to interpose another check by fixing the limit of purchase a peg higher, and providing for the

purchase of \$4,500,000 each month; but the production went on increasing. The British government suspended free coinage in the India mints, and the price went down lower than ever. Now, it is a striking coincidence that the price of wheat fell and rose just in proportion with the rise and fall in the price of silver—that is, in this country. It did not rise or fall in India. All the time the price has remained steady there, and the ounce of silver has purchased a bushel of wheat.

Disastrous Effects. Let us consider the effect on this market. When silver bullion was worth \$1.32 an ounce, as it was in 1872, it made the bushel of India wheat cost in Liverpool about \$1.45. Wheat from this country was worth then the Liverpool price less transportation, or about \$1.15 in Chicago. When they can buy our silver in London at 66 cents—and it was down to 63½ in 1894—the bushel of wheat can be bought in India, and in other silver countries, on the same basis as formerly, but at a cost when measured in gold of only just one-half as much and it can be landed in Liverpool at about 85 cents, it follows that we must accept for our wheat the Liverpool price, as before, less the cost of transportation. We are holding our coined silver on a parity with gold, while we are selling our bullion silver as a commodity at half price. The illustration as to wheat is equally applicable as to all those commodities which can be bought on a silver basis, in silver using countries, that are sold in the gold using markets of Europe in competition with ours. The lowest price from any country sets the price for all, and our misfortune is aggravated from the fact that the Liverpool price for our surplus also fixes the price for what we use at home. If we figure it out as to wheat we shall find that the effect upon the wheat crop of last year—467,000,000 bushels—would show a loss to our farmers and transportation companies, the greater part borne by the former, of at least \$280,000,000, although less than one-third of the crop was sent abroad. All the food products, wheat and flour, corn and oats, provisions in every form, and everything which enters into the production of them is affected in almost the same proportion.



JAMES H. MCCLINTOCK,
of Arizona, Member National Executive Committee and
Local Committee on Publicity.

Extent of our Loss. On all these taken together, and on cotton, the price of which has been similarly affected, although it is impossible to give exact figures, the aggregate loss cannot be less than \$400,000,000 on what we have exported, and four times as much on our total production. The total loss on silver itself is not to exceed \$30,000,000, and yet we are told there is nobody interested in, or to be benefited by, the silver legislation but the silver mine-owners. If the gold bugs can make the farmers of the country believe that, they may well be justified in their opinion, so often suggested, that the farmers are a brainless set, incapable of thinking or acting for themselves.

Opposing Interests. All of the gold standard countries except our own are among those classed as consuming countries. They have not hesitated to almost destroy their own agricultural industries—for they are suffering in common with ours, because in their case, as before stated, the manufacturing and commercial interests are paramount. As buyers of such products if they can save \$400,000,000 on the share purchased from us and proportionally on the vastly greater quantities purchased elsewhere, is it reasonable to suppose they will invite us to join them in

restoring the value of silver bullion, or that they will aid us in doing it? It is hardly creditable to the intelligence of the American people that they should submit so long as they have to a controlling influence in our legislation which means so much of hardship and suffering for the great mass of the people. THE IRRIGATION AGE will discuss the silver question along the lines herein indicated during the coming campaign, and fully believes that this country cannot hope for recovery from the present depression until it provides for the coinage of all silver that may be offered at the mint at the existing ratio. It would be infinitely better that every ounce of silver bullion should be sunk to the bottom of the sea than that it be permitted to go abroad under existing conditions with the effect to depreciate the value almost one-half of all our products.

Mexican Progress. A few years back Mexico began to gain ground with its industries and to prosper as the result of a more stable government. At first it began buying more largely from abroad, and for a while it looked as though the western cities would have a profitable market for many of its manufactured products. Being on a silver standard, and producing its own money metal—all it can use at home and a considerable amount for export—as gold has appreciated in other countries it has carried the prices of such goods as were imported to almost double the former price. Its enterprising capitalists have been quick to appreciate the great advantage it is giving them to introduce home manufactures in pretty much all lines. They have been buying machinery in this and other countries where stagnant business conditions have been reducing prices, have erected factories, have employed instructors for their home employes and are reaping great profits, as well as affecting great savings to the consumers, by manufacturing cottons, woollens and other textile fabrics, foundry products and machinery for their mines. More than that they are introducing American cattle and hogs for breeding purposes, with a view to the home production of meats and provisions. It is undoubtedly good for Mexico, but it is cutting off a very profitable portion of our western trade.

The Congress. The work now being done *Dec. 15 to 17.* in behalf of the Fifth National Irrigation Congress, to be held in Phoenix, Arizona, December 15 to 17, inclusive, promises, as far as attendance and entertainment go, to result in one of the most successful meetings yet held. The members of the local committee at Phoenix are men of business ability, integrity and enterprise. They are fully alive to the value of holding an irrigation congress in the Salt River valley, where the reclamation of the desert has reached an advanced stage, and they are ready to demonstrate to the outside world what can be and what has been accomplished with the use of water. Preparations for the comfort and entertainment of the delegates and visitors are already being made, and no one need fear attending for lack of accommodation, which will be ample.

What Will the Congress Do? The work before the congress is, in a measure, outlined in the autograph letters from leading western men, which appear elsewhere in this issue, but it is yet too early to predict what will be the outcome. There seems to be no pronounced sentiment in favor of any particular legislation. Matters are in a chaotic condition awaiting the coming of men of brains to lead them from the wilderness. In a recent letter the chairman of the executive committee said, "The general opinion of the committee is to have some legislation done at the next Congress," but further than this apparently nothing has been decided. It is to be regretted that the national executive committee, upon which devolves the responsibility, is not composed of men thoroughly familiar with the necessities of irrigation and the West. The placing of men upon this committee merely because they are residents of states which *ought* to be represented, irrespective of qualifications, and whether they are drummers for whisky houses or practical irrigators, or totally unfit from a moral standpoint, or other reasons, to lend dignity to the most important cause before the American people, has resulted, in a measure, in giving the public a wrong impression regarding the movement. Individual effort alone is responsible for the extension of the irrigation idea during the present year, and too much cannot be said in praise of those few

who have earnestly and faithfully labored for the general good.

The Northwest Overlooked. The great Northwest, one of the richest and most fertile regions on the globe, and where irrigation is being extensively practiced and advocated, has been passed in silence. Six large and important states—Washington, Oregon, Montana, Wyoming, North Dakota and South Dakota, are not even represented on the national committee. This condition of affairs causes thinking men to fear the future. No organization which omits from its councils over one-third of the area which it purports to represent can be truly termed national. No determined efforts have been made with a view to inducing the Northwest to resume its proper place in the movement, and yet it is noteworthy that the great bulk of the work in favor of irrigation in the last session of the United States Congress was borne by the men of the Northwest. What was accomplished is related by Senator Francis E. Warren of Wyoming, on another page.

The time is at hand for the irrigation movement to push forward, but it can do so only when it stands on a broad, comprehensive and intelligent basis, recognizing no state or section in preference to others; recognizing the fundamental principles upon which the reclamation of the arid lands are based, and straining every nerve to reach the desired end, not with a view to making or unmaking the reputation of one man or a set of men, but with an eye single to the main purpose—homes and prosperity.

Government Publications. The Indiana Farmer is advocating that agricultural reports of the government shall be so distributed as to be made accessible to farmers generally. In reply to its suggestion Assistant Secretary Dabney favors the idea and gives some information of public interest. The edition of the agricultural report annually is now 500,000 copies, published and circulated at a cost of \$400,000. Of these 470,000 copies are distributed through the senators and representatives, 1222 and 1000 each respectively. There are 4,500,000 farmers in the country so that only one-ninth could be supplied if all were legitimately used. He suggests that they might be sent, as



W. L. PARK,
of North Platte, President Nebraska Irrigation Fair
Association.

well as other public documents to the postmasters, but admits that it might be a question whether they would be willing to undertake such a work unless it were made obligatory. Would it not be altogether preferable that they should be sent to the trustees of each public school district, and form the nucleus of a valuable library that might be accumulated in time. It could then be made a part of the teacher's duty to take care of and keep track of them if they should be permitted circulation outside the school-room. They are valuable publications and are becoming more so every year as the experimental stations in all parts of the country furnish the most reliable data as a basis for public discussion.

Low Prices a Certainty. The government reports to July 1st indicate a very high average for the corn, wheat and cotton crops of this country and an average is indicated of European grain crops in the United Kingdom, Belgium, Russia, Germany, and Spain, and above an average in Austria, Bulgaria, France and Roumania. The French wheat crop is likely to meet home requirements for consumption.

The indicated crop of corn in this country is 2,154,600,000 bushels, as against 2,151,138,580 last year.

The indicated crop of wheat is 434,776,000 bushels, as against 467,102,947.

There is certainly nothing to give encouragement for better prices—extra large crops here with much of the old crop still unsold, and a limited export demand. The farmers are not in position to be over-jubilant with this outlook.

Water Development. The necessity for water supply in many portions of Southern California is leading to many remarkable developments as to underground currents. The Vineland Irrigation district, some two years ago tunneled under the river and got a fine supply of water for awhile. But the Azusa and Duarte people had a tunnel above them some 2,000 feet into the mountains and another diverting tunnel below. They built a flume between the two which left the bed of the stream dry, and cut off the developed (?) water of the Vineland district. The latter went into the courts about it but did not cease to dig for water while the suit was pending. They sunk a shaft from the bottom of their tunnel and



E. F. SEEBERGER,
of North Platte, Secretary Nebraska Irrigation Fair
Association.

have struck a flow of water which enables them to pump 100 miners' inches day and night into the tunnel. In the bed of the same river, the San Gabriel, a few miles below, the Killian well is yielding 350 inches constantly. The value of water in that locality is so high that it justifies large expenditures to find it and to carry it without waste after it is found.

Past Due Paper. It is said that manufacturers, jobbers and dealers in agricultural implements hold as much as \$60,000,000 worth of past due notes from farmers who are unable to pay. The farmers have been put in this condition financially by the steadily falling prices of their products during the past few years and it is difficult to see where relief is to come from, and how this vast sum can be finally paid, if similar conditions are to prevail for all time. It is not only the holder of the paper who is walking the floor in anxiety and distress, for his business honor is not generally more dear to him than to the farmer, who only delays payment through sheer inability. And while the half of the consuming population of the country is so much involved and therefore unable to buy only absolute necessities, it is not reasonable to suppose the country can have a revival of prosperity. It has set the farmers thinking and their thoughts are likely to have expression in their votes at the coming presidential election.

The Field Widening. It is encouraging to note the experimenting that is in progress all over the country, even in what is known as the rainfall area, to test the practical value of irrigation. The New Hampshire station has been trying it on the farm and garden crops, and with very excellent results. It is used there as supplementary, and to tide over the season of drouth. To have a sufficient water supply available for transplanting and for forcing special crops in the garden is a great advantage at any time. To have it ready for use, if it be needed for only a week or two, to prevent a crop suffering from drouth, whether in the garden or field, will justify a considerable expenditure.

A Wise Decision. The board of regents of the State University of California have decided to arrange for the holding of

meetings in various parts of the state, so as to bring out the opinions of farmers in regard to matters for their interest, which the university seeks to promote. Fifty meetings are to be held as soon as practicable. It cannot fail to awaken an active interest on the part of the whole people in the work of a university which has been admirably managed for years, and which has ever accomplished effective work in behalf of all the material interests of the state. It is a practical blending of theory and practice, a co-operation between the educated thinker and the skilled farmer, a direct alliance between field and laboratory.

For Small Remittances. The Implement Age calls attention to a business necessity which everyone having to make or receive small remittances will immediately recognize. Some kind of paper money—why shall it not be silver certificates? to represent the fractional coins as well as the full dollars?—that can be used for the remittance of small sums, without the trouble and expense of securing money orders and of collecting them, would be a very great convenience. The risk involved in the use of them is hardly worth considering as an actual fact, surely they are safer than the remittance of coins can be, and for a dollar or two the trouble in getting a duplicate money order or in tracing a lost one, is worth more than the amount involved.



DR. W. L. WOODRUFF,
of Phoenix, Arizona.

Fruit Shipments. Last year there were over fifty expedite fruit trains over the Union Pacific road from California, and it is expected that the number this year will be greatly exceeded. Last year it was proved by experiment to be entirely practicable to ship fruit by the train load to New York and thence by steamer to the European markets. It arrived in good condition and brought good prices. The first train of the season came through Chicago about the 12th of July, and included thirteen cars of green fruit and ten cars of tea, all billed to London. It is to be followed promptly by others, and California fruit is becoming as well known in London and Liverpool as in our own eastern states.

Steamships to Galveston. It was said that the great steamship companies would not recognize the Galveston port, no matter what the depth of water. The great North German Lloyd Steamship Company has seen its interest in arranging to establish a line of first-class ships between Bremen and Galveston which will soon be in regular operation. The rate for passengers and freight is but slightly more than from New York. One effect of the deep water harbors on the Gulf coast has been a reduction of six cents per hundred in the grain rate from Kansas to New York, and this is only a beginning. The Harrison line of passenger steamers is also to run regularly between Liverpool and Galveston.



IN THE BIG BEND COUNTRY ON THE GREAT NORTHERN RAILWAY.

WHAT THE NEXT CONGRESS SHOULD DO.

PUBLIC EXPRESSIONS FROM LEADING WESTERN MEN.

I AM pleased to note the very apparent interest that is being taken by THE IRRIGATION AGE in the coming session at Phoenix of the National Irrigation Congress, and will give you my opinion of the work that should especially come before the body.

At the risk of being considered decidedly rude, the first proposition I would advance is that the Congress should be made very unlike that excellent and valuable convocation usually known as a "farmers' institute." Of course the proper irrigation and cultivation of "goober peas" is an interesting topic (in its place), but its place is not in a national congress called for the advancement of the interests of the arid west. An able authority at Albuquerque put in an hour or two telling how to irrigate apricot and peach trees on uneven ground, but I doubt if his argument would have had much force before the senate committee on irrigation of arid lands. Another learned gentleman last year spent two hours in reading a paper on the influence of climatic changes on crops, but few there were who stayed to hear him.

From these I make the assertions: The coming congress to be a success must first be made interesting to its participants, and the work, considering agriculture and irrigation broadly and abstractly, must be confined to such matters as will advance through capital, through co-operation and through legislation the reclamation of arid and semi-arid America.

The Irrigation Congress should be rather a legislative body, an advisory committee we may say, to Congress and to the state legislatures. Its resolutions should be few and should be well digested and in them, if possible, should be embodied schemes for improvement rather than complaints against existing evils. Its work should be political in the broadest sense of the word "politics," and educational to the extent at least of showing the massed millions of eastern dwellers that upon the extension of agriculture in the west rests much of the nation's future

prosperity. Reclamation of the arid plains should, it is generally admitted, be under the auspices of the general government, for the greater portion of the lands to be reclaimed yet lie with title in Uncle Sam. The dollars needed can well be spared from the national treasury, yet the West will ask no more than to pay all costs as soon as water has been taken to the thirsty lands.

Matters of immigration are germane to the discussions, as are also the land laws affecting desert entries. Well to be touched upon also would be the hydrographic plats showing the points at which the storm waters of the West might best be impounded.

But no discussions on subsoil plowing, if you please; no sectional booming, no personal boasting, no personal animosities exhibited.

Add to all this, short, snappy addresses. Let the speeches be limited to fifteen minutes each, the balance to be printed if deemed worthy of printing. Then turn the wrangling over to special committees appointed from the floor, hold short sessions, and more will be done at the Phoenix Congress than at the other congresses combined.

I believe the Phoenix session is going to be a grand success. All signs, and there have been many signs of late, point that way. Phoenix has something of a reputation out West for entertainment, and all are to be assured that next December the reputation will at least be sustained. There will be plenty of room for all comers. About that time several thousand strangers are usually due to arrive, and quarters will be found with ease for double that number. We have a hundred-room hotel and a dozen or more of smaller hostleries, and by fall the Adams Hotel, to cost \$150,000, will be complete. It alone will have accommodations for 600. Further, Phoenix is considered by the drummers, and they are the best judges anywhere, to have the best eating at the lowest price of any town on the coast. There will not be a raise of a

nickel because of the presence of the congress.

As to reception, it is really too early to promise anything. It is to be expected that the local club, which will have commodious quarters at the Adams Hotel, will throw its doors open. The local railroads will be utilized for free excursions to points of interest in the immediate vicinity, and I have in mind a trip to some mines, to be reached by the Santa Fe in a couple of hours' run. Carriages will be at hand to convey all without cost to the farms and irrigation plants of the Salt River Valley, and at least one evening will be given over to a general reception of visitors. On the return trip facilities will be offered for visits to Southern California, to the Grand Cañon and other points renowned. These features, when matured, will, of course, serve to attract the casual excursionist, who knows and cares little of irrigation, and who comes mainly to see this wonderful country when the fares are low.

As to fares, I have already started correspondence with representatives of the Santa Fe and Southern Pacific systems, both of which enter Phoenix, and am assured that a rate of a single fare for the round trip will probably be made by the Western Passenger Association from all points between the Pacific Ocean and the Mississippi. This should bring a crowd.

Our local committee of fifteen on arrangements is now at work getting out advertising matter to be distributed broadcast.

The time of the session will be fixed at a meeting of the executive committee, to be held at the Windsor Hotel, Denver, July 30 and 31. It will, without doubt, be for the middle of December. This time was indicated at Albuquerque and for a variety of reasons. The main one lay in the fact that campaign time must be avoided, and yet the convention must be held within the year.

December is a pleasant time in Phoenix. The temperature is just right. The only disadvantage is that no deciduous fruits are to be had, but oranges will be ripe, fine big Washington navels, and they will, in a measure, fill the gap. We have a roof-garden scheme for a couple of sessions, if the weather is as it usually is, and delegates may return to the ice-bound East telling of an open-air meeting in

December, flanked by flowers and palms, and warmed by naught else than the rays of a genial sun.

JAS. H. MCCLINTOCK,

Member Nat'l Executive Committee.

Phoenix, July 1, 1896.

AS the time approaches for the convening of the Fifth National Irrigation Congress at Phoenix, Arizona, those who have watched these conventions in the past, and others interested in irrigation development in the Western United States, are wondering whether any good results will flow from the coming meeting. Certain it is that there is room for the accomplishment of much that would materially aid the cause of irrigation. The question then becomes, in what direction can this congress do the most?

To the writer it has always seemed that the irrigation congress might exercise a powerful influence upon legislation, both state and national, but especially the former. That most of the western states have not at present what can be called enlightened systems of water laws is a fact to be regretted, and it would seem that the intelligent representatives of these states in the irrigation congress should address their efforts to the remedying of this condition before everything else.

There can be no question that good and efficient systems of irrigation laws, uniform in so far as the governing conditions will admit, in all of the irrigation states, are a prerequisite to the highest success in irrigation development and practice. Upon such laws depends the safety, I may even say the very existence, of the capital invested in irrigation enterprises and of the users of the water. This being true, and the national government having confirmed in the states the right to enact the necessary laws, surely the irrigation congress, if its members are sincerely in earnest in their desire to advance the cause they presumably represent, should first devote itself to securing the adoption by the respective states of the best possible systems of water laws.

Second in importance is the question of national legislation upon the subject, though it is one which should have grave consideration at the hands of the congress. The arid public lands and their disposition; the general study of the water re-

sources of the country; the question of international streams, of navigable rivers and lakes whose waters may be needed for irrigation, and according to some, the matter of interstate waters, not to speak of the forestry problem, and the vacant pasture lands, are all questions for whose solution we must call upon the national legislature.

While not at this time suggesting any solution to the various problems referred to, the writer desires to urge upon those who will go to the congress, and especially upon the men whose duty it will be to arrange the program of the meeting, that they will give these questions their very earnest consideration, for upon them devolves a great share of the responsibility of finding and suggesting to the law-making bodies their solution. It is also hoped that every member of the coming congress will fully realize that the questions it is summoned to consider are paramount to any considerations of *who shall preside over the convention, or where the next shall be held.*

L. H. TAYLOR,

Member National Committee, Nevada.
Reno, July, 1896.

FIRST, I want to see steps taken by that gathering of the friends of irrigation to lift the whole irrigation effort into truly national proportions. The states of the Mississippi valley, at least, should be induced to join actively with the present irrigation organization, and so to aid us in carrying forward the great movement for reclaiming our arid lands not only, but for introducing irrigation methods, as such are now plainly seen to be needed throughout the humid states.

A second object to be set afoot by the Phoenix meeting should be the immediate inauguration of an irrigation survey of arid America by the general government into natural irrigation districts, with local self-government in relation to irrigation, and the forest and pasturage administration lodged, by both national and state laws, in the hands of the farmers and actual dwellers in those districts. All efforts short of something of this kind must be lacking in coherence and system. The time has come for us to plan for unity. "Nature has divided the arid lands into districts which are usually undefined."

My expectation is to report good progress to the next congress from the tops of the

Alleghany mountains to the waters of the Pacific. Kansas will send a full delegation.

We have *agitated* for four years; it is now time to *realize*. We have talked and resolved, and this talk and our resolutions have drawn the attention of our brightest minds to a consideration of the valid claims of arid America for recognition by the whole people. Now, it is for us to show by our deeds that we are "up-to-date" in deed and in truth.

J. S. EMERY,

National Lecturer, Kansas.

Lawrence, July, 1896.

1. THAT I would not be in favor of repealing the present desert land laws unless they should be replaced at once with a more comprehensive and efficient law. The stability of the United States rests largely on the encouragement of the small land holder; those features of our present law which aid land-grabbing by large corporations should be eliminated.

2. I unhesitatingly and earnestly advocate immediate opening of every Indian reservation to settlement and the forcing of all Indians to sever their tribal relations and take land in severalty.

3. I see no reason in justice why the Carey laws should not be immediately extended to include the territories. If honestly carried out it would aid in increasing their population and hasten the time of their statehood.

4. I am not in favor of leasing government reservoir sites to private individuals or corporations, unless under very close restrictions which will protect the small land holder.

5. I believe in liberal appropriations by the national and state governments for surveys and investigation as to water supply suitable for irrigation and construction of storage reservoirs, and systems of main canals as well.

6. I believe that the amended form of the "Wright Law," passed by the last legislature of the State of Washington, was a fairly safe law, and in an honest community would by an attractive investment. In a dishonest community no law could prevent fraud or attempt at fraud. The principle of the amendments I refer to is that of supervision of transactions by county and state officials whose position would be such that they would not be

likely to have personal interests connected with the district under consideration, and whose public position would be much of a safeguard against their connivance with fraud.

ARTHUR GUNN,
Wenatchee, July, 1896. Washington.

WITH respect to the topics for consideration at the next congress, I would suggest:

1. A *resumé* of the work accomplished by the irrigation movement in the arid regions during the last four years. This could, I think, be best shown by the selection of representative localities and a contrast of their past with their present condition.

2. A thorough consideration and demolition of the fallacy that the irrigation movement tends to create an overproduction of the necessities of life. This subject should be so handled as to show not only the unreasonableness of the opposition in the east, but also its utter futility.

3. Careful organization to carry the irrigation movement into the humid and semi-humid states. Effort should be made to strengthen the hands of those working in those states. This I believe to be of the highest importance, as by this means we can favorably influence legislation for the arid region also.

4. Some fair and candid statement of the position of the irrigationists with re-

spect to the general commonweal. This higher plane should be insisted upon. Hitherto appeals have been largely made to individual selfishness, and but little attention (generally) given to the broader side of the movement.

5. Attention to the connection between the railroad system of this country and the irrigation movement (what the railroads have done, are doing and can do). This subject should be made a prominent one, and ought to be exhaustively and fairly considered.

6. Persistent assertion of the fact that all irrigation legislation must *follow* and not *precede* public sentiment. No initiatory step can be looked for from the government.

Without suggesting for a moment that the above paragraphs exhaust the list, I have outlined some of the points which, in my opinion, deserve consideration. We are now at the outset of our career, and this meeting will determine our *status* as an economic factor in the progress of this country.

Personally, I feel that this is where we now stand, and in order that the movement should enter upon the second stage of its existence fully equipped, I think that no pains should be spared to make the Phoenix meeting a success from the start.

THOMAS KNIGHT,

National Committeeman, Missouri.
Kansas City, July, 1896.

THE INFLUENCE OF IRRIGATION ON CLIMATE AND HEALTH.

BY W. LAWRENCE WOODRUFF, M.D., PHOENIX, ARIZONA.

THE conclusive discussion of this subject implies a study of the physical conditions of the given locality—a comparison of meteorological data for a considerable period while arid conditions prevailed, with similar data after the same territory has been brought under irrigation—consideration of the percentage of humidity most conducive to health, with the prevailing temperatures, altitude and wind movements, and the determination of actual and ascertained general effects,

as shown by freedom from disease in the community and by vital statistics. Each of these elements of the problem must be studied in its relation to all the others. The inquiry is inherently difficult and complex under the most favorable conditions.

Captain William A. Glassford, Signal Corps, U. S. A., of Denver, Colorado, a high authority in such matters, says in a recent article: "In the hottest parts of this arid region the midsummer weather is not

only endurable, but even enjoyable and refreshing. These are the facts as they exist now, when the present conditions—the bare soil, etc.—are specially conducive to high temperatures. But it may be readily conceived that there will take place salubrious modifications, as some of us have already realized, when these desert places are covered with the green carpet of alfalfa and the verdure of trees;—when the wasting waters are stored and diverted by the irrigator to the surface of a soil only waiting for water to produce bountifully, not only the fruits of the earth in due season, but almost to produce the seasons themselves at will.”

In the nature of the case we could not expect any definite scientific data for this vicinity prior to the practice of irrigation. The precipitation is about seven inches per annum. Settlement and residence are impracticable in a locality in which agriculture must depend for moisture solely upon irrigation. In the Salt River Valley, settlement and irrigation came hand in hand.

The Salt River Valley, with Phoenix as its center, is situated in the vicinity of the 33d parallel of north latitude.

The surrounding physical and climatic conditions are totally different from those of any other locality under irrigation, and must be understood in order to arrive at right conclusions.

It has an elevation ranging from 1,000 to 1,500 feet above sea level.

High mountain ranges surround it on all sides, save on the southwest, where it verges into the larger Gila Valley.

The Gila Valley, under similar conditions, extends to the Gulf of California, which in turn extends with its 53,000 square miles of surface well into the tropical zone.

This great, inland sea, with its mouth 250 miles wide, flanked on either side with continuous mountain chains, acts as a funnel into which the tropical waters and winds sweeping from the equator up the Mexican coast, enter.

These surroundings and winds are largely the influences which go to produce our peculiar and phenomenal climatic conditions.

It is universally conceded that an atmosphere carrying too much moisture is unfavorable to perfect health. It may not be so well known, but is equally cer-

tain that the air may be too dry. A couple of my patients had this experience. During a long drive upon the desert, on an exceedingly hot day, the air became extremely dry and fairly burned. Their throats became parched and perspiration ceased. No amount of water taken internally seemed to relieve this condition, which was speedily followed by a languor and then stupor, bordering on coma. This thoroughly alarmed the wiser of them, and sensibly, during the remainder of the day they took turns, fifteen minutes in duration, one driving while the other gratified the irresistible desire to sleep, and in this way they reached irrigated ground in safety. The same phenomena have been observed in numerous other cases. I am satisfied this explains many cases of death upon the desert which have heretofore been attributed to lack of water. During the summer time, in this locality, elimination by the kidneys is reduced one-half. Perspiration is immensely increased and the skin becomes the chief eliminating organ of the system. When the percentage of humidity in the air gets below a certain point, evaporation from the surface of the body becomes too instant, the surface burns, perspiration and elimination of effete material ceases, thus producing the phenomena above described. I attribute these effects entirely to a lack of sufficient moisture in the atmosphere.

I am not prepared, as yet at least, to fix definitely the point at which the percentage of moisture in the air is neither too great or too little. Investigation may, and probably will, show that the most favorable degree of saturation would vary according to individual characteristics. It is probable there is a range of 10 or 12 degrees within which it is difficult, if not impossible, to say that any given point would be more favorable to general health than another. It may be safely said that in the temperature of the Salt River Valley, during the summer, a humidity below 8 per cent is disadvantageous, while that above 20 per cent begins to become oppressive.

Both actual and sensible temperature, as shown respectively by the readings of dry and wet bulb thermometers, must always be considered in connection with the humidity. In every climate there are seasons when the percentage of humidity is excessive, and results generally in a

feeling of depression. In the Salt River Valley these periods are usually limited to say a week in February and a week in August, very much less in duration than in any other locality within my observation. There is very little wind here. The mean average hourly movement at Phoenix for a period of years is stated by the United States Signal Service at 2 and 37-100 miles. It would be interesting to compare the humidity of the higher lands of the valley near the foothills with that in the lower valley, but no data exist for such statement. We know that it is 10 to 15 degrees warmer in winter and cooler in summer, for instance, on the lands under the Rio Verde Canal on the north side and the Highland Canal on the south side of the Salt River than near the river at Phoenix. The extremes of temperature between day and night are much less on the higher lands than in the lower valley, and the danger of taking cold is proportionately reduced.

It is probable that the effects of irrigation on climate and health under the high temperature and low relative humidity of this valley are somewhat different from those in regions of lower temperature, greater humidity and either higher or lower altitude.

It is almost impossible without accurate observations to make comparisons, or to arrive at safe, definite conclusions as to the influence of irrigation on climate, either in a general way or in a given locality. I have been unable to procure any data whatever as related to this valley, or to any similar locality, showing the relative humidity before and after irrigation. Without such facts I can only state conclusions arrived at from personal observation and study of its effects, on this locality.

I am decidedly of the opinion that upon the deserts of Arizona, without irrigation, the moisture in the atmosphere is sometimes so little as to interfere with health and comfort, and produce feverish conditions. The evaporation of water from the irrigated land supplies this deficiency to the air and obviates the injurious tendency.

I have frequently had this experience. The "wetting down" of my well shaded porch on a hot summer day lowers the temperature, shown by the thermometer hanging upon the wall, 10 to 15 degrees.

This results from the refrigeration of the air in the process of evaporation of the water.

It is well known that a well shaded dwelling in the midst of an alfalfa field is much cooler than the same residence surrounded by bare ground. This is due in part, perhaps, to the absence of reflection from the earth, but chiefly I think to a similar slight refrigeration of the air by the evaporation of the moisture in the earth and vegetation of the surrounding field. The effect becomes still more marked when a gentle breeze is blowing.

At Phoenix, during the summer months, the air is so dry that the midday registration of relative humidity ranges from 6 to 15 per cent. It rarely goes above the latter point, and if it were not for irrigation it would drop still lower, which is not desirable.

My conclusion is that the evaporation of moisture from irrigated surfaces slightly increases the moisture in the air and promotes the healthfulness of both animal and plant life.

That the evaporation from irrigation has but slight influence in increasing the dampness in the surrounding air will be readily understood when we recall the following facts: That moist air is lighter in weight than is dry air. That moisture is evaporated as an invisible gas. That being lighter and a gas it is not a disturbing atmospheric element. That it instantly rises with great velocity to a point in the atmosphere where the temperature is below its own dew point, where it becomes visible in the form of clouds. But a very small portion of the evaporated moisture is retained in the lower and warmer strata of air. The hotter the air the greater is the evaporation from the irrigated ground. This evaporation lowers the earth's temperature and also that of the surrounding air.

During the winter months the temperature ranges much lower, evaporation is much less and the air is constantly so dry that the slight influence it exerts is scarcely noticeable. During the last winter the mean relative humidity was as follows: 1895, Oct. 53%, Nov. 68%, Dec. 58%; 1896, Jan. 54%, Feb. 45%, Mar. 38%, Apr. 32%, with a rainfall during these same months of but 2.70 inches.

It is well known that the best qualities of citrus fruits can only be grown where

there is sometimes danger from frost. This danger in the citrus localities of the Salt River Valley only exists for say an hour at a time, and that about sunrise of a frosty morning. The horticulturist is able by flooding his irrigation ditches with water at this time, to obviate, or lessen, the danger to his fruit. The water in the ditches will freeze before the fruit or the tree and thus the temperature of the surrounding air is raised. This phenomenon exists all over the district under irrigation, to a greater or less extent, and the extremes of day and night temperatures are thus modified.

As to the influence of irrigation on the healthfulness of the inhabitants of an irrigated district I can be more positive. It is demonstrated by actual experience to be advantageous. Phoenix and the Salt River Valley is the healthiest place in the United States. Next to it comes Salt Lake City, Utah, also in an irrigated district.

That part of the Salt River Valley north of the Salt River, west of the Verde, and east of the Agua Fria, covering a territory of 250 square miles and including the City of Phoenix, of which the population on a conservative basis for 1895 is placed at 15,000, had for the year named an annual death rate of 5.04 per one thousand inhabitants. Salt Lake City during the corresponding year had a death rate of 7.37. Our death rate for the five summer months last year was but $\frac{1}{4}$ of one per cent. of our population, or 2.54 for one thousand inhabitants in the above named territory. With this showing no one for an instant can imagine that in the least does irrigation militate against health.

On the other hand I believe that irrigation is a major factor in increasing the healthfulness of a community. It is probable that on account of our favorable climatic conditions this is more emphatically true of the Salt River Valley than any other locality. I refer this fact chiefly to three causes.

Under an irrigation system properly operated there are no water holes, or sloughs in which vegetation grows only to decompose and pollute the air. There are no pools of stagnant water to create miasms. The water supply is under man's control, both as to volume and times of distribution. Vegetation is rank and prolific, but grows only where it is desired, and is limited to valuable products. Useless vegetation is discouraged, but should it by chance exist, it rather dries up than rots.

This low death rate is further explained by the constant living in the open air, which we enjoy to its utmost limit.

Irrigation by promoting the rapid and phenomenal growth of trees and the verdant grass which carpets our lawns makes a continuous existence out of doors possible and enjoyable for three-quarters of the year.

We live nature's life as nature intended we should live it, and have our reward of unparalleled healthfulness.

I do not believe there is any other place on earth where children are so universally healthy. This is especially true of the summer season. They are marvelously free from "summer complaint" and kindred ailments. I never saw any place where the children thrive as they do in the Salt River Valley.

To quote Capt. Glassford again, he says in the same article: "This greater portion of Arid America, elevated high above the humid levels of the east, covered with aspects most sublime of the earth, fed with the most invigorating constituents of the atmosphere, will yet be appreciated; and these elements, under the influence of modern civilization, will produce the hardiest and grandest race of men and women who have yet trod the planet. They will create a Western empire and become masters of the continent, if not of the world."



THE SOUTH DAKOTA ARTESIAN BASIN.

A GEOLOGICAL STUDY.

BY FRED F. B. COFFIN.

THREE conditions must be present to make any country a desirable place to live: a good climate, a fertile soil and an abundance of pure and wholesome water.

That South Dakota possesses the first two conditions in an eminent degree is past controversy. It is the purpose of this article to demonstrate from known facts that the third condition exists here in quantity, in permanency and in purity second to no State in the Union. As a further preliminary I will state that it is utterly impossible to treat this subject in its entirety in an article designed for the public press, hence, only the salient features will be presented.

South Dakota lies at the foot of one of the largest catch basins in the United States, being no less than the upper Missouri Valley. The drainage area of this valley from Sioux City, Iowa, northward is 314,900 square miles. All the drainage of this vast area, with slight exceptions, surface and phreatic, must pass through South Dakota on its escape seaward. This vast area seems to have been carved out by the hand of nature with consummate design.

A glance at a map will show that this area embraces nearly all of North and South Dakota, the north half of Wyoming and the eastern portion of Montana.

An examination of the topography of this area discloses the cause of many conditions. Starting at Sioux City, Ia., and going northward along the course of the Jim river, which is the lowest part of the basin, we find the elevations above sea levels as follows: Sioux City, 1,097 feet; Huron, S. D., 1,285 feet; Columbia, S. D., 1,315; Jamestown, N. D., 1,406 ft.; and at Devil's Lake, 1,464 feet, showing a gradual ascent northward of a little less than one foot per mile.

Going east from the Jim river, say at Huron, we reach the "divide" between the Missouri and the Mississippi valleys at Lake Benton, Minn., at an elevation of

about 1,900 feet, or 600 feet above the Jim river. Again going westward from Huron we reach the summit of the "co-teaus," which is the dividing ridge between the Jim and the Missouri rivers, at about the same elevation as at Lake Benton, Minn., or 600 feet above the Jim at Huron. We then descend to the Missouri river at Pierre, reaching an elevation of 1,440 feet. Crossing the Missouri we reach the top of the bluffs on the west at about 1,700 feet above sea level. The ascent is then gradual till we reach the foot of the Black Hills, say at Rapid City, where we are at an elevation of 3,192 feet, about 150 miles west of Pierre, making an average ascent of about 9 feet to the mile. The general elevation of the Black Hills is about 7,000 feet. Harney's Peak being 8,020 feet. Going westward we find the summit of the ranges of mountains dividing the headwaters of the tributaries of the Missouri and the Platte in Wyoming to be about 10,000 feet. Going northward we find the summit of the mountains in Montana, dividing the headwaters of the Missouri and Columbia rivers, to be about 7,000 feet. Or, in other words, that Montana is 3,000 feet lower than Wyoming. Now, going eastward we find the dividing ridge between the valleys of the Missouri and the Assiniboine to be a little over 2,000 feet.

This gives us the contour of this vast catch basin and shows clearly why the flood waters flow to a common center. Now let us examine briefly the geological structure of this area and see if we can find a receptacle for the storage of phreatic waters.

East of the Missouri river we have first the drift or quarternary ranging from 50 to nearly 100 feet in thickness, with a general average of about 100 feet. First is the soil or black loam ranging from 1 foot to 6 feet in thickness, ordinarily yellow clay comes next, underlying the soil. Yet in many places we find sand immediately under the soil. The yellow clay is ordi-

narily about 25 feet thick. In this yellow clay we frequently find sheets of sand varying in thickness and extent. Nearly all these sand sheets or "sand pockets," as we sometimes call them, are filled with water.

Under the yellow clay and above the blue clay is generally a stratum of water-bearing sand. Here we get what we call our shallow or surface wells. In many of these wells we get quite good water, in some of them the water is not fit to use. As these wells are supplied by water imbibed from the rainfall, many of them fail in extreme dry seasons. Yet some do not. In these wells the water seldom rises above where we find it. We next come to the blue clay; this is about 65 feet thick. Under this we ordinarily find a stratum of sand varying in thickness from a few inches to 30 or 40 feet. In this sand we expect to find an abundance of pure and good water that comes rushing up, sometime flowing out at the top of the well. As the elevation increases and as we approach the hills or coteaus on either side of the Jim, the water does not come so near the surface. But the water always rises and is abundant. Chemical analysis has failed to find a trace of animal or vegetable impurity in this water. In some instances there seems to be mineral deposits in the vicinity of the well which renders the water unfit for use. But in most cases the water is pure and wholesome.

These wells do not fail in our driest times. This fact has led some to believe that these wells were at least partly supplied by a leakage upward from the artesian waters beneath, and there is some evidence to justify this belief. The principal supply is evidently the imbibition of the rainfall on the highlands of the State, which finds its way down into the sandy stratum that underlies the blue clay, and is thus stored in this vast receptacle ready for man's use.

We now come to the shale of the cretaceous formation. This blankets this entire catch basin, and from its impervious nature holds the waters down that are in it and beneath it. I will not stop to designate between Pierre, Benton and Niobrara shale, but call it all shale. As we pass down through the shale we soon begin to find sandy streaks; these increase in number and thickness until we find what is known as the Dakota sandstone, which is the base of the cretaceous formation. In

the southern part of the State we find the Dakota sandstone at about 500 feet; in the central part of the State at about 900 feet; in the northern part of the State at about 1,000 feet; at Jamestown, North Dakota, at about 1,500 feet; at Deloraine, Manitoba, just across the boundary, they are down 1,800 feet, and have not found it yet. On the east side of North and South Dakota it abuts against the Minnesota granite. At the Black Hills, and all around the mountain rim, it crops out.

This Dakota sandstone is the receptacle and source of our artesian waters. It varies in thickness from a few feet to nearly 200 feet. The line of demarkation between the shale and sand-rock is not sharply drawn, the upper part being nearly all shale and the lower portion being nearly all sandstone. We must consider the aggregate thickness of the various sandstone strata to understand its storage capacity. The broken condition of western South Dakota and all of Wyoming and Montana drained by the Missouri river affords abundant opportunity for the imbibition of the storm waters.

According to the weather bureau, the average annual rainfall of South Dakota, taking the entire State, is about twenty inches. It ranges from about fifteen inches in the driest to about twenty-six inches in the wettest portions. Wyoming and Montana are about fifteen inches; North Dakota about eighteen inches. In the broken and rugged part of this vast catch basin a large portion of this rainfall (and this includes snow) finds its way down through the broken rocks and sandy streaks and is silently stored away in the sandstone for man's use. Just how much of this water is thus impounded we cannot at present tell, and conjectures are idle. We do know this, that the capacity of this vast storage basin is beyond computation. We do know that it is full to bursting, notwithstanding there are vast leakages on the southern border. We do know that its upturned mountain rim, with its shale-blanketed surface, affords the means of both hydraulic and hydrostatic pressure, as is evidenced every time a hole is made to give it vent.

There seems to be an arm or tongue of the quartzite reaching out westward from Sioux Falls by Mitchell toward Chamberlain. South of this line the pressure is about fifty pounds to the square inch;

north of this line the pressure ranges from 100 to 185 pounds to the square inch, according to location and other conditions.

The flow of the wells vary largely, from a few hundred gallons to nearly or quite 4,000 gallons per minute, according to the location of the well, its size, the thickness of the sand-rock, its character, whether fine or coarse, and many other conditions I cannot discuss in this paper. It may be that this basin will soon be emptied, but it seems to me that as long as the rains

and snows continue to fall, and the mountains continue to lift their majestic heads high above us, the danger is remote.

With a sheet of water under us thirty or forty feet thick, with a head reaching back hundreds of miles and thousands of feet above us, and being constantly increased by a fresh supply, it seems to me there is no cause for alarm. The resistance of the sand-rock holds this water back, so that we cannot draw this water off rapidly if we would.

ONE REASON WHY FARMING DOES NOT PAY.

BY W. C. FITZSIMMONS.

THE following facts and figures show the stupendous folly of raising wheat for export at recent low prices: For the first eleven months of 1894 there were exported from the United States 65,465,292 bushels of wheat and 14,762,232 barrels of wheat flour. Reducing the flour to its equivalent in wheat at the rate of $4\frac{1}{2}$ bushels to the barrel, the entire export was equivalent to 131,895,336 bushels of wheat. The average price of wheat at points of export was 59 cents per bushel, making a total value of \$77,818,248 for the eleven months ending with November of that year.

It should be remembered that the above sum was not what the farmers received for that amount of wheat exported. Not by a long way. The wheat buyers, the transportation companies, the elevator companies, the warehouse companies and other handlers as well as the men who produced the wheat are all paid out of the amount received. The 59 cents, therefore, represented what the farmers received plus all the charges attaching to the grain from the time it left the farmers' hands until it was put aboard ship in New York or San Francisco.

It is not recorded that the transportation companies or other agencies having to do with this wheat after it left the farm lost anything by the transaction, but how was it with the farmer?

We shall say nothing about the cost of land and improvements; nothing at all about the labor and expense of plowing, sowing, reaping, threshing and hauling to market. To be sure they are generally regarded as the main costs involved in the production of wheat; but our purpose is to show here an enormous item of loss to

farmers which is seldom, if ever, taken into account.

To reduce a large amount of "ciphering" to a few figures it is this: At the prices of 5 cents a pound for potash, 6 cents a pound for phosphoric acid and 15 cents a pound for nitrogen, every bushel of wheat produced cost the farmer who produced it $23\frac{1}{2}$ cents for these ingredients alone. To be sure he may not have paid out that much hard cash for these substances with which to fertilize his crop; but that amount of such ingredients was withdrawn from the soil, which is practically the same thing. No man who raises wheat can possibly escape these inexorable facts of chemistry. This being a fact then the amount of wheat sent across the sea during the first eleven months of the year 1894 carried away from our soil potash, phosphoric acid and nitrogen to the value of \$30,995,400, and for the first eleven months of 1893 the amount was \$40,219,964.

The farm value of the entire wheat crop of 1893 was given in round numbers by the Department of Agriculture at \$213,000,000, and that of 1894 at \$225,000,000. From this it appears that during the first eleven months of 1893 the value of the potash, nitrogen and phosphoric acid exported was equal to 19 per cent of the value of the entire wheat crop harvested that year. In 1894, owing to a greater aggregate farm value for the crop and smaller exports, this percentage was reduced to 14. But in spite of these facts, which can tell but one story of inevitable disaster if persisted in, the farmers increase their acreage in wheat from year to year while the price goes lower and lower.

THE ART OF IRRIGATION.

CHAPTER XV. THE IRRIGATION OF HILLSIDES. WINTER IRRIGATION.

BY T. S. VAN DYKE.

THE modes of applying water so far given cover all ways that are generally justifiable in field, garden or orchard. Special cases on small scales will often justify the expense and trouble of sub-irrigation and sprinkling. But one should be cautious about deciding even this point. There are lawns by the score in Southern California that are flooded, yet look just as fine and soft as those that are sprinkled and do not take one-fourth of the water or one-tenth of the trouble. It is all in the laying out. The same with flowers of all kinds. Whatever you can do by sprinkling you can do more easily with little furrows or basins around them provided you do it right and give plenty of water when you give it at all. The idea that the absorption of water by the leaves makes them look brighter is old granny nonsense. So while such things as strawberries could be kept clean by sub-irrigation they can be kept just as clean by setting them on high broad ridges between deep furrows and filling the furrows with straw or some good mulch. If the ground is carefully laid out to even grade and the furrows well made, the water, if fed evenly to the furrows, will never rise above the mulch.

When you once admit that looks are of no consequence, the problem of irrigating hillsides is half solved. Yet it is marvelous how general is the idea that hills cannot be irrigated and how stubbornly the idea clings to the average skull. What is today the most valuable, elegant and profitable part of Redlands, California, is slope that in 1887 was considered too great for the use of water. And some of the very best is land that three years later when the orchards were fast scaling the heights was still thought too rolling to be of use. The Indian and the Mexican had for a hundred years grown rows of trees along ditches running along steep hillsides and in this way raised some of the finest fruit. And still the white man did not see that the principle could be extend-

ed to several furrows instead of one and to a whole orchard instead of a single row of trees. And outside of California you will be called crazy today for intimating that slopes of even one to one can be irrigated. Yet fine orchards stand on slopes almost as bad as that today and they are not terraced either.

All you have to do is to abandon all ideas of quincunx or any other symmetrical form and plant the trees around the hill on those lines on which the water will run best. First the whole should be graded to a face or faces of uniform slope as in any other land. Then the lines running lengthwise of the hill on which the water will run may be determined, by trial, by simply letting the water follow the hoe as the Indian builds his ditch. Having found the slope on which it will run without cutting or becoming muddy you can continue in this way if you use care enough or can go faster with a board and a carpenter's level. Suppose you find fifty-five feet to the mile about right. This is about two inches in sixteen feet. A sixteen-foot board beveled on one edge until it is two inches wider at one end than at the other, when set with one edge horizontal will represent the slope with the other edge. So if you keep the upper edge level with a common carpenter's level the lower edge will be the grade of the furrow desired. Small mistakes will not matter. Three strips of scantling nailed into a triangle with a nail for a plumbbob hanging from the apex are also very good. Level the base of the triangle and then find how much raising of one end makes the plumbbob swing off, say an inch from a mark made where the string hangs when the base is level. You can easily give any grade you want in this way. You can also do the same by nailing blocks on the end of the plank instead of beveling but it will be harder to follow than the others, which give the exact line of the bottom of the furrow.

When a row of trees is set on one of these lines it makes a good guide for the plow in the future, and as it is about as easy to make curved furrows as straight ones when you have a guide, there is no trouble about having the intermediate ones nearly parallel to those next the trees.

Sometimes these furrows are fed from a row of hydrants at one end and if the hill is very steep they are better than a flume down which the water may rush too fast. But you can use a flume with very little loss of water from flying over, by making it a little deeper than is needed and laying it in steps with a slight covering at the points where the water is likely to spill. But many flumes are laid straight down the hill and made extra deep with little cleats at the holes to throw out enough water. If made deep enough there is little loss from spilling. In other respects this is just like the small furrow method on common ground, and you will soon forget all about the difference in looks.

Where basins are used they are made very long and narrow so as to avoid having the water too deep on the lower side. And on this ground it is still more important to feed the basins from furrows for you will find any other method troublesome, where the slope is great. You must in all cases use more care to keep the water from escaping and cutting.

An orchard laid out in this way and well cultivated is liable to cut under heavy rains. To prevent this, run all plow and cultivator lines lengthwise of the hill and none up or down or quartering. The water from the rain will then get no such start as it otherwise would.

In California the weeds and grass are allowed to start with the first rains and grow until spring. A very slight growth is enough to bind the soil so that it will not cut under a heavy run of water unless too long continued. As the rains come here in winter, when cultivation is of little importance, no harm is done and the weeds and grass are easily cleaned out in the spring.

Where a hillside is very steep terracing often becomes the best mode of preparing it for irrigation. The water is then run along the terraces in small streams or into checks or basins as desired. Some very fine orchards and vineyards are now

seen on hundreds of hills where but a few years ago it looked as if a goat would need several good props on the lower side to enable him to feed. The terraces are made broad or narrow according to the depth of the soil, the character of the crop and the way the water is to be applied, as well as the purse of the owner.

Hillsides generally hold moisture well on the northern slopes and dry out rapidly on the southern. This must be remembered in deciding what to plant on hill-sides, as well as the difference in the time of maturing the crop. Many things like grapes and olives seem to do as well on the steepest hills as elsewhere, the only difference being in the ease of handling water. Where you are using basins see that the most water goes on the upper side of everything. Otherwise there is little difference between the steepest hill and the flattest ground.

NOT CONFINED TO ORCHARDS.

Hillside irrigation is by no means confined to trees. The same principle of planting on the lines on which water will run the best without cutting, apply as well to most all vegetables and garden stuff as well as flowers. Nor is there any trouble in growing alfalfa on considerable of a slope if you once get it well started without cutting. When well up the roots will hold the soil against quite a run of water. I know no place where large fields are raised in this way because bottom land is so much cheaper. But there are hundreds of small patches that show plainly that it can be easily raised on any slope on which you can run a mower. And it takes less water than flooding generally requires. There is no reason why the same could not be done with grain, provided the ground were so wet at planting that no more water was needed until the grain was quite high, when the stalks and the grass that would be among it would prevent any cutting. The furrows must of course be made before planting and then not disturbed. If the water wanders out of them in course of time it will make little difference.

WINTER IRRIGATION.

Little attention is yet paid to winter irrigation, because its necessity has not been thoroughly felt. But time will see the field of irrigation much extended by

the use of water at a time when it is now almost everywhere allowed to run to the sea.

Where a country is underlaid by sheet rock very near the surface, through which the water can travel only in fissures, moisture cannot be retained very long by any means. But where the subsoil is porous and retentive of moisture, or where the top soil is very deep and of about the right mixture of clay, sand and gravel, the length of time it will hold moisture enough for many crops is very great.

Southern California ships annually about fifteen hundred carloads of beans that are raised without irrigation and generally without rain, and always without rain that amounts to anything. The grower aims to keep the seed out of the ground until the last rain of the season is over, so that he can start out with the ground so cultivated that the winter weeds and grass are killed. The beans will then get ahead of the summer weeds and grass, which are much later. Consequently the entire crop is raised on the moisture stored in the ground from the winter rains and retained by good plowing and pulverization of the top soil into a mulch. Corn and many vegetables are raised in the same way, while over one-half the entire fruit crop of the State and probably four-fifths of the deciduous fruit trees never get a particle of water or rain after the setting of the fruit. It is difficult to see why this cannot be done anywhere else where the depth of soil or porous subsoil is great enough, as it is on the greater part of what is called desert. If the winter rainfall of twenty inches, of which one-third runs off and is lost in direct surface evaporation, will do it, it is certain that a foot or fourteen inches in depth from a ditch will do the same thing where the summer is not too hot and dry. And where it is so hot and dry as to need more water, it will not need what it would had the ground not been wet in winter. And on the greater part of it the raising of a fair crop of grain on ground thus thoroughly wet should be an easy matter without farther wetting, and enough for a profitable crop of hay a certainty.

The difference in California between the amount of water needed in the summer following a very wet winter and a very dry one is enormous. And still more surprising is the way the water in the ground

from an extremely wet one is carried ahead to the second year. After the very wet winter of 1883-4 when, on the greater part of the lowlands, forty inches of rain fell in four months, hardly anything needed water until very late in the fall, and then it was needed mainly by oranges and lemons in full bearing. Almost everything that matured its fruit by September was fine without any irrigation. Crops of corn equal to the best ever seen in the prairie states were common all over the uplands a hundred feet from any subterranean water and leagues beyond the influence of any coast fogs or moisture.

The next winter was a very short rainfall with very bad distribution. Yet the effects of the great wetting of the year before were everywhere plain in the summer following this short rainfall. Crops of grain, corn, beans and various other things were raised everywhere on the uplands to an extent that would have been utterly impossible on the amount of rain of that second winter.

Probably two feet of water entered the ground that wet winter. There are few irrigation systems that are worth anything that cannot in addition to the summer supply furnish at some time of the year this quantity of water to consumers. If in a state having a wet winter season like California, the rainy period is generally long enough to put more water than that amount into the ground; if on a desert like the Colorado where the high water comes during the irrigating season the winter is long enough, and there is then water enough in the river to fill the ground quite well. There are exceptions, as on the Rio Grande, where I have seen the winter-flow insufficient to wet much territory. But I have seen times there in the spring when a vast amount of water went to waste that could have been employed somewhere in filling up the subsoil. As a rule there is at some time plenty of water under any system that could be had without extra charge and in addition to the regular water-right, as it costs nothing to carry it in aqueducts already built. But so far as I have seen, the fault lies not with the companies, but with the consumers, who will not use the water but prefer to take their chances on there being plenty in the dry season.

If water cannot be stored above ground the next best place is in the ground, and

there are but two objections that can be made to filling the ground in winter.

The first is that it chills the soil too much. For oranges, lemons and a few other things ripening at this time, care should be taken against applying water too cold. But for grain, deciduous fruits and all crops not planted until warm weather, such as corn and beans, it can do no harm. In California most deciduous fruits are all the better for being held back by cold ground, as is shown by the superior quality of the mountain fruit over that of the lowlands. Some, such as cherries, apples and some varieties of plums and pears, actually demand a soil cold in winter. Probably such is the case in all the lands of sunshine.

The second objection often made is that if the season turns rainy toward the end, you then have the soil too wet. The winter of 1883-4, above referred to, proved that in California there is little in this objection. On all ground well enough drained to be fit for oranges or lemons at all, the quality of the fruit was not in-

jured by the excessive soaking of that winter. On low ground, trees of many kinds were killed, and some of the raisins grown on them were too watery, but there was no trouble with anything on the uplands. While there is in some places a possible danger of having the ground too wet, there is more of having it too dry. And while the quality of fruit may be impaired by over-irrigation, the danger is seldom alarming. Men do suffer from over-work, but there is much more suffering from under-work. It is the same with spoiling flavor with too much water. And if you are working the ground for lucre instead of glory, it may even pay to sacrifice flavor to size. For, deplore it as we may, man is still the master fool of the universe, and first, last and all the time he grabs for the largest fruit, whether fresh, canned or dried, and gladly pays for looks what he will not pay for merit.

NOTE.—Owing to the fact that our offer to allow editors to use T. S. Van Dyke's articles, provided due credit was given *THE IRRIGATION AGE*, and also provided the articles were not used consecutively, has been grossly abused in many cases, the offer is now withdrawn, and the copyright will be fully protected.

WATER SUPPLIES FOR IRRIGATION. STORAGE RESERVOIR SITES AND CANALS.

BY F. C. FINKLE, C. E.

VERY frequently good reservoir sites are found without any adequate watershed which is directly tributary to them and from which they can be filled. In such cases, of course, the reservoir sites are valueless as such, unless water from some adjoining watershed can be conducted into them. Before a reservoir site is condemned and rejected on account of not possessing a watershed sufficient to fill it, an examination should be made to determine the practicability of filling it from some other adjacent watershed. Surveys for this purpose should be made of the watershed under contemplation in the same manner as has been recommended in the case of a watershed directly tributary to the reservoir site, with the following additions: A suitable point or points of diversion should be selected at a sufficient elevation above the proposed reservoir site to permit the carrying of the water to be diverted from the point of its diversion into

the reservoir site at a point not lower than the top of the dam.

The survey of a line suitable for a canal or other conduit for carrying the water from the watershed to the reservoir site should be made with sufficient accuracy to give its length, grade, cross-section and other data necessary for estimating its cost. A canal of this kind is called a storage reservoir supply canal, as it is used to perform the function of supplying water to a storage reservoir.

Storage reservoir supply canals partake of the nature of other canals used for carrying water for irrigation purposes, and their construction must be carried out in accordance with the same principles which will be laid down for the construction of irrigation canals in one of the succeeding chapters devoted to that subject. There are a few differences, however, arising from the fact that their use is confined to the rainy and cold season of the year,

when they are sometimes required to carry very large volumes of water in a very short space of time. It therefore follows that they must be of much larger size and capacity than if the carrying of all the water required were evenly distributed over the entire season. To determine what the capacity of such canals should be, it is necessary to know the maximum floods from their watersheds and what portion of the flood-waters is required to fill the reservoir sites they are intended to supply.

Another point requiring special care is the construction of the diversion dams to take the water into such canals. The suddenness with which the floods rise and fall and the large quantities of water the dams are required to handle, make it necessary that they should be made very safe and strong. Should the diverting dam fail, the water needed to fill the reservoir might run to waste before the dam could be repaired, and another opportunity might not occur to obtain sufficient water for filling the reservoir before it would be needed. Hence the importance of perfect designing and construction of head works for such canals. Often the elevation of storage reservoir supply canals is considerably above sea level, so that even in warm climates there may be danger of their filling up with snow and ice at the time when they will be most needed. It is frequently the case in semi-tropical climates that considerable snow falls and cold weather occurs at high elevations just before and during the time of heavy rains. This being the case, canals in such places may be filled with snow and ice when the water comes down which they are intended to carry off. The way to overcome this difficulty is by the construction of snow-sheds to prevent the drifting snow from filling the canal. These matters will be more fully discussed in the chapter on canals, but are referred to in this place for the purpose of showing which are the principal matters to be considered in making estimates of the cost of bringing the water from a watershed not directly tributary to a reservoir site into such reservoir site.

PROXIMITY OF RESERVOIR SITES TO LANDS SUSCEPTIBLE OF IRRIGATION.

In general, the points already discussed cover everything essential to impart value to a storage project. Sometimes, however, reservoir sites are found so distant from lands where the water can be used for

irrigation that the cost of bringing the water to the lands, added to the cost of the reservoir, is greater than the profits to be realized from the enterprise will warrant. This is especially the case where an artificial channel to convey the water for the whole distance has to be provided. It is, therefore, always a part of prudence and good practice on the part of an irrigation engineer to know what will be the expense of conveying the water proposed to be stored by a reservoir to the lands where it is intended for use. For this purpose surveys of one or more practicable routes from the reservoir site to the point of delivery on the land to be served should be made.

These surveys should be made with sufficient precision to furnish the data required for making thoroughly reliable estimates of cost. In cases of reservoirs very distant from lands susceptible of irrigation, it is often possible to convey the water in the natural channels of rivers and streams for the greater part of the way. Thus it is often feasible to make a large saving in the expense of constructing artificial channels by utilizing those which nature has already provided. It does not follow, however, that all which is necessary is to find a natural river or creek channel in which the water will flow down to or near the place required. It often occurs that the loss of water in such conduits is so great as to make their use impossible. This point must therefore be investigated in order to find what will be the percentage of loss. Such examinations can either be made by actual measurements at times when water is flowing in the channels in question, or by comparison of the conditions and nature of the channels with others in which the percentage of loss is already known. It should be remembered, however, that the former method is always the more certain and reliable, and is therefore to be preferred.

A CORRECTION.

There was an error in the formula in the second column on page 19 of the July number being in line 23 of that column from the top in Finkle's article on Water Supplies. The error consists in making the fractional number $\frac{2}{3}$ appear as a factor in the formula instead of as the coefficient of the factor A. The formula will then read as follows, which is the way it was intended: $Q = \frac{2}{3}A$ (pcf).—ED.

DECISIONS UPON THE SUBJECT OF WATER RIGHTS.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IT is safe to say that California owes the greater portion of the prominence which that State occupies to-day to the results of irrigation. The localities where irrigation has been practiced the longest and the most extensively have gained the widest reputation outside of the State. Almost every step taken in advance in California's prosperity, since the subsidence of the first great rush for gold, has been anticipated by new and more extensive irrigation developments. It is no exaggeration to say that were it not for irrigation the fame of California would be confined to the mining industry, and she would not have more than one-half of her present population. Without irrigation the major portion of the State, which is to-day thickly populated and in the highest degree productive, would still be in its original barren condition.

The methods of practicing the art of irrigation are many and diverse. We can also say the same of the laws regulating and controlling its practice. Its laws permit the acquisition and retention of water rights by means of all the known systems. One can acquire title to water rights by the means of prior appropriation, whereby he diverts the water from the natural channel and applies it to irrigating the soil or to some other beneficial purpose. The riparian proprietor is protected in his rights in and to the waters of the stream or the lake flowing over or adjoining his land, and greater license is allowed him than was permitted under a strict construction of the common law rules, in his being permitted to divert from the stream a reasonable amount of water for the purpose of irrigation. Rights acquired under the civil Spanish and Mexican laws, before California was transferred to the United States, are protected to the fullest extent. Also, at different times, statutory enactments have been passed by the State Legislature regulating and controlling the uses of water. And last, by the statutory enactments of 1887, and the subsequent amendments, the "District System," familiarly known as the "Wright Law," was created, which is without doubt the most

famous irrigation law in the United States, although it has been held by some courts to be unconstitutional. This view of the law seems to the writer to be the wrong one. But how the Supreme Court of the United States will decide the case which it has before it remains to be seen. But it is unfortunate for the people of California that the case could not have been decided this spring, instead of being kept under advisement over the long summer term. However, it may result in the case being decided right. It is a great subject. There are some of the old principles of law that may have to be modified. But there can be no question but that the law, in a great degree, meets the needs and necessities of the arid West.

RIGHTS OF RIPARIAN PROPRIETORS.

It has always seemed strange to the writer that the legislature and courts of California should try to reconcile and retain principles of law governing waters so adverse to each other. Take, for instance, the laws of appropriation and diversion as against that of riparian rights. In the first, in order to hold the right, the water must be diverted from the natural channel of the stream and actually applied to some beneficial use. In the latter the stream must be permitted to flow, as it was accustomed to flow, without any substantial deterioration in quality or diminution in quantity.

One of the methods of reconciling these adverse propositions is seen in the case of *Wiggins vs. Muscupiabe Land and Water Company*, decided on the 5th of June, 1896, and reported in 45 Pac. Rep., 160, where it was held: That in determining the rights of riparian proprietors to the waters of a stream, for irrigation, it is within the power of a court of equity to apportion the flow by periods of time, rather than by division of the quantity, when such apportionment may be extended to the use of the water for domestic purposes, when necessary.

Mr. Justice Harrison, in rendering the opinion of the court in the above case, said: "The power of a court of equity to

apportion the flow of water in a stream to the respective riparian owners by periods of time, rather than by a diversion of its quantity, so that each may have the full flow of the stream during such designated periods, instead of a portion of the flow during all the time, when the circumstances are such that a division in this manner would better conserve the rights of all the riparian owners, was fully considered and established in *Harris vs. Harrison*, 93 Cal., 676. It was said in that case: 'According to the common law doctrine of riparian ownership, as generally declared in England and in most American states, upon the facts in the case at bar the plaintiffs would be entitled to have the waters of Harrison canyon continue to flow to and upon their land, as they were naturally accustomed to flow, without any substantial deterioration in quality or diminution in quantity, but in some of the western and southwestern states and territories, where the year is divided into one wet and one dry season, and irrigation is necessary to successful cultivation of the soil, the doctrine of riparian ownership has, by judicial decision, been modified, or rather

enlarged, so as to include the reasonable use of natural water for irrigating the riparian land, although such use may appreciably diminish the flow down to the lower riparian proprietor, and this must be taken to be the established rule in California, at least where irrigation is thus necessary.' In an arid country water for irrigation may become a natural want of man, as exigent as when needed for domestic purposes, since without it vegetation would cease, and the sources of life be indirectly destroyed. When, as in the present case, a stream, instead of increasing as it goes toward the sea, constantly diminishes, until it finally disappears, or ceases to have any appreciable volume, it is very evident that its beneficial use can be regulated better by periods of time rather than by a division of its quantity. A perpetual use of the water by all of the proprietors would be impracticable, for the reason that a perpetual use by the upper proprietor would, during a large portion of the year, entirely deprive the lower proprietor of any flow, and a just protection of the rights of both is best effected by a division in periods in time."

A FURROW-MAKER.

BY JOEL SHOMAKER.

A FURROW-MAKER is valuable to all classes of farmers in every section of the country. The irrigated districts require field furrows in order to properly distribute moisture. The prairie farmers need furrows to guide in planting and cultivating. Where land is level, furrows are beneficial in wet seasons for drawing the surplus water from the growing crops. In dry weather the same furrows retain what moisture falls, and distribute it by seepage and percolation to the roots of the crops in plats between the furrows. Furrows facilitate the cultivation and harvesting of crops. As every farmer must have more or less furrowing, the best, easiest and cheapest methods of making are always sought.

An old backwoods Western farmer has discovered what he thinks is a model method for making furrows. All his crops are rolled after planting, and as irrigation is required, he must have distributary furrows. These are made by having a furrow attachment upon the roller. His

roller is made of wood. A big cottonwood log ten feet in length was hewn down to make the roller. Three feet from either end of the log he left the log full size and chopped down, sloping on either side, leaving the extra sap probably three inches wide on the outside. The main body of the roller is probably six inches lower than these rings of timber. In driving over the planted field, the roller levels the land and the rims of timber cut in and make the furrows.

To prevent the pieces of wood from breaking off, the entire rim was covered with an old wagon tire and spiked with twenty-penny wire nails. Straight furrows can be made as easily with the roller as with any other two-horse implement. The driver sits in the center in a spring seat and has nothing to watch but the course of the roller. This method could be used on rollers not made of logs just as well. Iron bands would answer the purpose if they were large enough and properly put upon the roller.



ONE YEAR OLD APPLE ORCHARD, K. S. D. RANCH, NEAR ONTARIO, ORE.



FOUR YEAR OLD ORCHARD.

WELL DRILLING MACHINERY.

WITHIN the past two years thousands of wells have been sunk on the western plains, in what is distinctively known as the sub-humid regions, for purposes of irrigation. The universal success of such wells will insure the rapid adoption of this method of reclaiming arid or semi-arid lands. In many places it is the only resource; in many others, where water supply is accessible from canal systems, it is found to be much less costly in the long run, and much more satisfactory, because of the independent control it affords. There are few localities where water is not found coursing in underground channels, close enough to the surface and in sufficient quantities to provide for the necessities of a few acres of land, and even though not more than five or ten acres on a quarter section can be irrigated, that is quite enough to insure the farmer a good living, and if well handled, a considerable surplus every year, regardless of the natural rainfall. Indeed, a single acre of garden has served this purpose in many instances. The balance of the farm will always yield something, if it is only in pasturage, and the wells will incidentally provide ample stock water. When the seasons are favorable the products of the remaining acres will be a clear profit.

Nor are such wells only practicable in the localities named. The time is not far distant when irrigation will be adopted in every part of the country where intensive farming is practiced, even though it be only as a "tide-over" for dry periods. Vegetable and fruit growers are learning that the cost of installation and of maintenance of a pumping plant that will insure them full crops every year is one of the best investments that can be made in

connection with their business. The hay crop, which is the chief money crop in many sections, is so greatly increased and improved by a bountiful supply of water at all periods of its growth as needed, that it will justify far more than the average expenditure needed to provide for irrigating water. There are few localities where such an increase in crops as is assured will not justify an annual expenditure, including the interest on investment, of five or six dollars an acre, and under ordinarily favorable conditions it will not cost half that.

Motive power utilizing wind, gasoline, oil, coal or wood for fuel is being so cheapened and perfected that either of them are found to be practicable, each having special advantage in some localities. Pumps with large capacity and specially adapted to the wants of the irrigator are now on the market, and the competition has cheapened them until they are within the reach of all. Well-drilling machinery has been improved, and at the same time its price has been so reduced as to make that part of the problem an easy one. In fact, all the elements are now in combination to promote the rapid extension of the individual irrigation system.

Unfortunately there are not many manufacturers of this line of machinery, as it is one requiring many years of experience to produce machines which do not prove more or less troublesome and expensive. Among the most reliable are the F. C. Austin Manufacturing Company and the Chicago Tubular Well Works, both of Chicago. The tremendous strain to which well-drilling machinery is subjected should cause the purchaser to be very careful when buying, so that he may get machinery that has been fully tested and approved.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, cornercribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

HOW CULTIVATION PRESERVES THE MOISTURE.

BY F. C. BARKER, OF NEW MEXICO.

THAT cultivation of the upper crust of the soil tends to prevent evaporation of the moisture below, is a fact that every practical farmer is well aware of. It is daily being proved in actual practice, but the scientific theory upon which this phenomenon is based is little understood. Men will tell you it is so, but why, they do not understand.

Now, it is well known that the soil is composed of innumerable and infinitely small particles. When the soil is dry each little particle is surrounded by a vacuum or air space. Whenever the particles come in contact with moisture, they have the power of attracting that moisture and of surrounding themselves with a thin film of water. The particles next to the water first draw the water around themselves, then the dry particles next to them in turn attract it, and so a continuous stream is set up, much in the same way that a wick of a lamp draws up the oil. This goes on until the whole body of soil is saturated, but as soon as the water reaches the particles on the surface of the soil, this water is evaporated, and the supply below is again drawn upon, until the water stored below is so exhausted, or left at such a depth, that the distance overcomes the power of attraction and the soil becomes completely dry. This is the process which goes on in uncultivated soil.

The object of cultivation is to break up this attraction, usually called capillary attraction, in the upper crust and so prevent the moisture from being brought to the surface and evaporated. To understand how this is done, one must take into account another scientific fact, and that is,

that if these little particles in the soil be widely separated from each other they lose their power of attraction. Now, when the top crust of the soil is loosened and reduced to a fine tilth, these particles lie less closely together and do not attract moisture from below. The moisture now rises as high as the upper tilth, and there remains to a much longer extent than in the case of untilled soil, for owing to the blanket or mulch of loose soil on the top, the soil below the surface is much less exposed to the action of evaporation.

Some of our farmers here are unwilling to accept the above theory, alleging that adobe or clay soil, that has never been cultivated for years, will have more moisture below than cultivated soil. If this be so, the fact does not clash with the theory of particle attraction. On such soil the top surface has been packed down so closely that the surface is practically puddled, in which case the attractive power of the particles is destroyed. It is the same as though the surface were covered with a large rock or a board, whereby the evaporation were suspended. Every one knows that moisture may almost always be found under a large rock. The idea is to cover the soil with something that will suspend the attractive power of the soil-particles and retard evaporation.

Herein lies the whole secret of why land should be cultivated after each irrigation or heavy rainfall, if the farmer wishes to conserve the moisture in the soil. There is also another and very important reason why crops should be cultivated after each irrigation. The roots of plants require air quite as much as they do water, and when the soil becomes packed or plastered down by irrigation the roots do not get a full supply of air, unless this surface crust is broken up.

MISCEGENATION OF GRAPES AND APPLES.

LA NATURE, a French periodical, mentions a remarkable case of cross-fertilization. Whether it is true or not, we cannot say, but this is the yarn: A grapevine stood near a large russet apple tree, and a bunch of twenty-nine apples formed on the grapevine and grew to considerable size, even if they did not mature, which latter fact is not stated. The "grape-apples" were wedged so closely together that they were "sharpened to a point," somewhat like grains of corn on a cob. The blossom end of each fruit, however, was found to be as perfect as in any other apple. The matter has been taken up by the Imperial Pomological Society, and it is to be hoped that valuable facts may be established from the discussions incident thereto.

ZINC TREE LABELS.

J. D. EASTER writes to the Redlands Citrograph: "Your issue of the 20th contains a paragraph concerning 'An Indestructible Tree Label' which I can commend as trustworthy, from many years' experience. I was taught this by a nurseryman thirty years ago, and have practiced it ever since, with satisfactory results. For ordinary use it is not necessary to write on the zinc with chloride of platinum, or any other costly fluid. Clean the slip of zinc thoroughly and write on it with a steel pen dipped in ordinary black ink. The ink will soon corrode the zinc so that the writing will be perfectly legible, no matter how much it may be exposed to the weather. I have labels on fruit trees in my yard which were made two years ago. The ink has disappeared long ago, but the names are there to stay. How they would resist being buried, I do not know, but labels are not usually intended for this purpose."

State Flowers.—While many States have struggled, more or less unsuccessfully, with the momentous question of selecting a "State flower," and have put in nomination all sorts of ugly weeds with horrible names, it is a pleasing piece of news that the school children of Delaware, by an overwhelming majority, selected the peach blossom as a State flower. That shows a degree of horse sense for which

every Delawarean kid should have an extra hunk of gingerbread and a slice of watermelon, besides the usual allowance of peaches and cream. The following is the list of State flowers already adopted by the votes of the public school scholars of the respective States: Alabama, Nebraska and Oregon, the golden rod; Colorado, the columbine; Delaware, the peach blossom; Idaho, the syringa; Iowa and New York, the rose; Maine, the pink cone and tassel; Minnesota, the cypripodium or moccasin flower; Montana, the bitter root; North Dakota, the wild rose; Oklahoma territory, the mistletoe; Utah, the lego lily and Vermont, the red clover. In addition, Rhode Island and Wisconsin have adopted a State tree, the maple being selected by both.

Feeds Eggs to the Calves.—J. W. Rutherford, of Sumner county, is very enthusiastic on the subject of alfalfa, cows and creamery. It is not all theory, either. He has had three years' experience with alfalfa and has been one of the largest patrons of the creamery since last fall. He has sold horses and wheat machinery and invested the proceeds in cows. A great many farmers say there is more profit in feeding the milk to calves than in selling it to the creamery, but Mr. Rutherford says he has had fine success with feeding skimmed milk from the creamery to his calves. He thinks he can raise just as good calves on the skimmed milk, and has about \$5 for each cow per month for the cream. He also says he stirs an egg into each feed of skimmed milk, and his calves are sleek and fat. He has made a close study of dairy papers and has got all the information he could from friends in the dairy business in Pennsylvania.—*Exchange.*

Cultivate Rather than Irrigate.—It is easier to turn on water to wet the hard, baked soil than it is to cultivate, but the man who does it will never be apt to reap a heavy reward for his labor. Every such wetting is a positive and permanent injury to the land, putting it into a mechanical condition that makes it difficult to cultivate satisfactorily ever after. Give the soil deep saturation when you do irrigate, and cultivate it as quickly as the teams can be got on, and while it works without

clodding. Keep the surface soil fine and mellow and the evaporation will be hindered while the capillary action will be promoted below.

The Cheapest and Best Fertilizer.—

A German authority finds the weight of the stubble and roots of a heavy crop of red clover to weigh about three tons and to contain 180 pounds of nitrogen, 7 pounds of phosphoric acid and 77 pounds of potash. The first was gathered from the air and the other two brought up from the subsoil. These were worth at the market price of these fertilizers about \$30. The stubble and roots of an alfalfa field are much heavier and proportionately more valuable. A good crop of alfalfa turned under when in its best condition and making most rapid growth, or just completing it, is the cheapest method of adding these fertilizers to the soil, and at the same time puts the soil in the best mechanical condition.

A New Fruit Pest.—The sanitary inspector of British Columbia has seized a quantity of Tasmanian apples, arriving by an Australian liner. They were infected by an insect about the size of a flea, which burrows into the apple and deposits its larvæ. It threatens to be a more offensive and worse pest than the San Jose scale, and a united effort will be made by the authorities at all importing points to prevent its introduction into the Pacific coast states and British Columbia.

Milk Tests.—The introduction of reliable milk tests by which it is made practicable to buy milk according to the butter fat it contains will eventually lead to the more just and sensible practice of purchasing it with reference to quality rather than quantity. Recent experiments have shown a range of between three and five per cent. of fat. In one case three hundred pounds of the best would bring as much as five hundred pounds of the lean milk.

Fertilizer in the Water.—The muddy water of the early spring in nearly all the irrigated countries carries more or less fertilizing substance which has been dissolved from the soil, or is gathered by the rush of waters, and it is a wise farmer who schemes to save as much of such value as

is practicable. If the watershed is forest-covered it is all the more important to save the vegetable mold which is so readily carried in the quick-moving current.

Topping and Stripping Corn.—Tests at the Mississippi experimental station during three seasons have uniformly shown a marked decrease in the yield of corn and deterioration in quality which is not compensated by the feeding value of the crops. The records of seven other stations where similar tests have been made show a loss of sixteen per cent. upon topping. Stripping causes even greater loss.

Road Making.—Use fresh soil for the repair of roads. That which has been ground into an impalpable powder and washes into the ditch is not fit to put back again; it is worn out. Remember this in repairing chock holes. The pulverized stuff, mixed as it is with animal droppings, may be an excellent dressing for the gardens, or a good absorbent for the cattle-yards, but it is not good road-making material.

Cool the Fruit.—If fruit is taken from the trees when warmed by the sunshine, it is in an undesirable condition for packing. If practicable to spread it under a shed on straw or leaves to lie over night, it will be thoroughly cooled and in much better condition for shipping. This is particularly the case as to pears, quinces or apples.

Danger from Spraying.—From several localities come reports of injury and death to bees resulting from the feeding on the poisoned blossoms of vines and trees that had been sprayed. Mr. Stroud, of McCook, Neb., found so many dead bees in his hives that he thought it necessary to destroy honey, bees and hives. They had been poisoned by Paris green and London purple mixture.

Don't Waste Manure.—No matter how good your soil may be, never permit the waste of any manure or fertilizing material that may be made or found on the farm. The best of soil may be made more productive; in fact, the best of soils will generally pay best for the fertilizers used on them, if care be taken in providing the particular elements that the soil may be deficient in.

Mixed Grain.—The Ontario experiment station, as the result of two years' tests, finds that a combination of barley, wheat, oats and peas, all sown together, produces 244.05 pounds of grain to an acre in excess of the average yield obtained by planting the same grains separately. The yield of straw is also larger.

Restoring Fertilizer.—Every crop taken from the land removes a certain number of pounds of the three essentials—nitrogen, phosphoric acid and potash. If it is not replaced the land suffers to the extent of that draft upon it. The intelligent farmer will seek the most effective way to restore that loss.

Nut-Bearing Trees are beginning to attract a larger share of attention. They become profitable as producers after seven or eight years and are all the time growing into value as timber, so that in twenty-five or thirty years they will prove themselves among the most profitable of farm products, if cultivated as such.

Low Priced Nursery Stock may not be cheap stock in any sense. Give first attention to quality; find the best, then buy it as cheaply as you can. Don't buy it at all if it is not good. There is hardly any worse investment to be conceived of than to put money in poor trees and in the cultivation of them for a term of years.

Spraying Potatoes.—By the use of Bordeaux mixture, at the Vermont experiment station, the total product of potatoes in 1892 was increased from the rate of 169 bushels per acre from an unsprayed plat to 400 from a sprayed plat. Other stations report similar favorable results.

The Experiment Stations are performing a large amount of careful conscientious work for the benefit of the farmers generally. The latter should not only appreciate it, but good judgment dictates that they should take every possible advantage of it.

A Hint to Potato Growers.—A Connecticut man made a simple and effective spraying machine by mounting a ten-gal-

lon keg on a wheelbarrow and inserting a wooden faucet at each end. He sprays two rows at a time as fast as he can walk, making it an inexpensive operation.

Exchange.—It may be better to exchange good sires, either of cattle or hogs, after they have proven their quality, than to kill them, if it be necessary to introduce new blood into the individual herds or in localities where they have done general service.

Keeping Potatoes.—In a suitably constructed building potatoes may be kept an entire year, or longer, without deterioration, under cold storage. There is no necessity for potatoes to become shriveled or sprouted if kept dry and cold from the start.

Good Cows command the best prices of any animals raised on the farm, and the demand for them is steadily growing. It follows that it is in this direction in which the enterprising farmer ought to turn. The more emphasis there is put upon "good" the better.

A Canadian Fruit Grower experimented with two of his cherry trees by spraying one of them. From the sprayed tree he gathered 130 pounds, which he marketed for \$9.25, and from the other he got but eighteen pounds, which brought him \$1.20.

Sub-Irrigation a Failure.—After five years' trial on the experiment station farm at Logan, the practice of sub-irrigation, in every way that it has been tried, has proven a failure, and about the same results have been obtained at stations in other states.

When to Cut Grain.—Experiments show that grain harvested in the milk or dough makes better yield and better quality than when allowed to ripen on the stalk. It will also gain weight from the straw while standing in the stack.

Escaping Frost.—Prof. Kedzie, of the Michigan Agricultural College, says that tender plants and fruits of all kinds, if thoroughly watered late in the evening when frost is expected, will escape unharmed.

When You Sell Hay off the farm you are selling its crop constituents; when you feed it and make good use of the manure resulting, you may sell the animal product and yet add to the fertility of the land.

A Big Crop of Weeds, if properly utilized, may not be a misfortune. Plow them under when they are making vigorous growth and before any of them have gone to seed, and they will prove a valuable fertilizer.

The Value of the Farm is enhanced by keeping the roadside clear of brush and weeds and trash, not only by tidiness in appearance but by the destruction of weed pests.

Canning Establishments.—The Western canning establishments are driving the French peas out of the American market. By more skillful packing the quality of the home product has been materially improved.

Tree Cultivation.—Trees do not differ in any fundamental method of living from vines and crops that are always cultivated. Cultivation is as necessary to the one as the other.

The Pruning of an Orchard should be practically done before the trees are five years old from planting, and with proper care and attention it may all be done with the thumb.

The Waste of Wood Ashes is almost criminal, as there is hardly anything in the way of a fertilizer which returns so much of value to the soil according to the weight.

Printer's Ink is better than tar to protect seed corn from the birds. Stir a little ink with the corn and then dry by rolling the corn in fine dry sand.

Trees and Plants need food and water, and they should be as regularly and intelligently supplied as the animals on the farm. It is only a difference in kind.

Tree Planting.—Plant the different kinds of trees with a view to separate irrigation. Some kinds need much more water than others, and they need it at different seasons.

Warm Stables.—Building paper, forest leaves or sawdust between the boards to keep the stables warm are much cheaper than grain and hay to keep the animals warm.

Stock that has paid during this long and severe depression will be the most profitable when the good times come again. This is worth remembering and thinking about.

The Costs of Transportation and sale are as large for a poor as for the best article. All the advantage in the way of profit lies with the best product.

Horses are so cheap now and there is getting to be so little for them to do that the farmer can with good grace use riding machinery wherever practicable.

Present indications are that the horse industry will be first to recover from the depression which has characterized the live stock markets.

Good sanitary conditions are the best preventive of cholera or other diseases, and this applies as to men, animals or poultry.

The essentials for summer cultivation are to kill the small weeds and keep the surface loose. Cultivate shallow and often.

A horse's collar in harness should be as carefully fitted as we fit the shoes upon our feet, or the coat upon our back.

You must cultivate your small fruits and trees the same as any other farm crop from which you expect to realize profit.

The commercial demand for horses is growing, and it is getting to be a question how it can be supplied.

A Massachusetts fruit grower estimates the cost of spraying his orchard at ten cents per tree for the season.

Save the best for seed—this applies to colts, calves, lambs, pigs, pullets, grains, fruits and vegetables.

A good rooster is better the second year than the first. Don't make a mistake in killing or selling it.

A cow cannot give full returns in milk unless she receives full feed every month in the year.

MAXIMS FOR THE IRRIGATED FARM

Cultivate as well as irrigate.

Irrigation is the best crop insurance.

Never attempt to do more than can be done well.

The best savings bank for a farmer is his manure pile.

The strongest man is the man who stands for an idea.

The surest way to success is to do well whatever you attempt.

The man who enjoys his work as he does his bicycle succeeds at it.

There are more book farmers and less blockheads than formerly.

New conditions demand new methods in farming as in other business.

Workers make better progress than kickers, whether horses or men.

It is the man who masters the conditions which confront him who succeeds.

It is better to fill your own place in the world well than to covet another man's.

Great crops may make large business, but low prices afford only small profits.

Marketing the crop successfully is of quite as much importance as growing it.

The man who works so hard he cannot think may with reason be classed as a fool.

Intelligence is the tool which makes an opportunity where none else will appear.

Success depends more on the use of the ability one has than on the abundance of it.

Study the application of water in irrigating for its permanent as well as present results.

The man who is better fitted for feeding hogs than for growing fine fruit ought to feed hogs.

The farmer who works most by rule will have the better results to show at the end of the year.

There is no place where careful attention pays better proportionately than in the poultry yard.

The farmer's welfare is the nation's welfare; the last cannot exist in this country without the first.

Drainage is the first necessity in road making. Without it the best work will fail to accomplish its purpose.

It is a careless man who keeps no record of his business, and this applies to farmers as well as to other people.

Don't sell all of the best and perfect fruit; give the family a share. Few children enjoy eating the culls all the time.

A man who is too busy to read the papers is too busy for his own good. It is necessary to keep in touch with these rapid moving times.

When you see a man who has no garden, orchard or fruit patch you may be pretty certain he does not read. He scorns the idea of being a "book farmer."

The farmer who breeds mongrel cattle, hogs or fowls will in time exhaust a big bank account, if he has one, or will become poverty stricken if he has not.

But comparatively little of a man's education has come from books. Experience is the best teacher and its lessons are never ended so long as intelligence lasts.

A man in this age who waits for something to turn up is more than likely to die before the turn comes. The one who turns up something is the more useful man.

The lucky farmer is universally the one who gives the most careful, painstaking attention to the details of his business, whatever branch of the industry he may be engaged in.

The American people do not like to be humbugged in the fruits they buy, and the grower who recognizes that fact when packing for the market will act wisely for his own interest.

It is often better policy for the farmer to sell some of the land he has than to buy more. More land than is properly and profitably cultivated is a burden rather than a benefit.

PULSE OF THE IRRIGATION INDUSTRY

A GOLD EXHIBITION.

A RECENT issue of the Chicago Record contained the following item which explains itself:

A meeting was held yesterday at the Wellington hotel to make arrangements for an exhibition of gold industries in Chicago some time in the fall. The Chicago Western society has the matter in charge, and the intention is to have exhibits from all gold-producing countries, together with an exhibition of the systems of mining, crushing and assaying ores.

The gold regions of Colorado, California, Washington, British Columbia, Oregon and the newly developed gold fields of Georgia were represented and enough gold to start a national bank was pledged for the exhibit.

The Cariboo district will exhibit a brick worth \$42,000, representing a twenty-nine-day washup on one claim. French creek and Trail creek districts, which have been reported by prospectors engaged by Cecil Rhodes and Barney Barnato as being the richest gold fields in the world, will exhibit several carloads of rich ore.

The Canadian Pacific road, through its agent, Mr. J. F. Lee, promised several carloads of ore and quartz.

Letters were read at the meeting yesterday from mine-owners in Russia, China, Australia and Africa signifying their willingness to take part in the exhibition.

Several full-sized crushers will be in operation and also apparatus for extracting the gold from the quantities of placer washings which will be on hand. There will be working models of everything connected with a gold mine, from the most primitive wooden rocker to the latest magno-electric machine of chilled steel.

Quite a discussion was aroused at the meeting by proposals from G. E. Girling, editor of *The Irrigation Age*, and Mrs. Alice Houghton of the Chicago mining exchange to admit silver and copper to the exposition. The question was left undecided.

MONTANA CROPS.

WITH a crop of grain raised in the Gallatin valley last year amounting to two million bushels, the prospects for this year are an important consideration. The first few weeks in July were hot and dry, so that much grain suffered before it could be properly irrigated, and oats and spring wheat will show a slight decrease in the yield per acre over last year. Barley, however, looks well. Winter wheat

being raised upon non-irrigable land, the rolling bluffs surrounding this great valley, has been seriously scorched, and will probably show a decreased yield when harvested the latter part of August, which will be 25 per cent. below that of 1895.

Potatoes are looking well, while the hay crop is larger in acreage and in yield than ever before, having been so far advanced at time of drought as to be unaffected by it, and the part that clover will take in the hay crop exceeds previous years, with the quality excellent.

The average decrease in yield per acre here of cereals this year will be 8 per cent. below that of 1895, but a larger acreage should make the total in bushels a little above last year's crop. The prospects, therefore, are excellent in a general way; although individually not up to the average yield, will be appreciated.

P. C. WAITE,
Bozeman, Mont.

MUCH IN LITTLE.

It would be worth millions to Kansas if her fly-by-night farmers could be induced to emulate the postage stamp, which sticks to something till it gets there.—*Hon. Edwin Taylor, address to Kansas Agr'l College.*

Wages of farm labor are as high as ever, while household help is not to had at any price. This state of affairs seems to be general, yet the price of farm products was never so low. This thing has got to be evened up.—*Orange Judd Farmer.*

A telegram reached grain buyers last week directing them to pay only six cents for oats. This is the proposed prosperity under the McKinley regime.—*O'Neill, Neb., Beacon Light.*

In the language of the street, Nebraska is "strictly in it this year." J. M. Thurston was a central figure in the St. Louis convention. W. J. Bryan was the idol of the Chicago convention. W. V. Allen will be bellwether of the Populist convention. Bentley is the silver Prohibitionist nominee for the presidency. And Nebraska

will have the biggest corn on earth, this fall, too. In fact there isn't anything desirable in sight that she has not taken in.—McCook, Neb., *Tribune*.

Postmaster Hesing of Chicago says the present fight is "the proletariat against the plutocrat." Some time ago it was simply a craze that had died.—Ogden, Utah, *Standard*.

They call that man a statesman whose ear is tuned to catch the slightest pulsations of a pocketbook, and denounce as a demagogue anyone who dares to listen to the heartbeat of humanity.—William Jennings Bryan.

WHAT CONGRESS DID.

IN summing up the work in behalf of irrigation, accomplished at the last session of Congress, Senator Francis E. Warren of Wyoming writes that the finished work consists of:

Two appropriations amounting to \$54,500 for the gauging or measurement of the water flow of streams.

An appropriation of \$175,000 for topographical surveys.

An amendment to the so-called Carey law permitting the states to pledge their state selection of United States lands, under the 1,000,000 acre allowance, as security for the money or labor necessary to take out irrigating canals for the reclamation and preparation of the lands for settlement.

A provision (in the river and harbor act) that the United States Engineers shall examine and report upon at least one reservoir site each in Wyoming and Colorado.

Of the first mentioned, \$4,500 was appropriated in the annual Agricultural appropriation act for gauging streams, and \$50,000 in the sundry civil act. The gauging of streams is comparatively a new work. Some \$15,000 was expended for the purpose during the last fiscal year. While not entirely devoted to irrigation, yet quite a portion of the gauging work to be prosecuted under these appropriations will be in localities where irrigation is intended.

The appropriation for topographical work is in the sundry civil act, and is \$25,000 more than for the last year, and the act contains a provision that at least

two iron posts shall be erected in each township of six miles square of the public survey, erected as near township or section corner stones as possible, and bearing upon each a label showing the altitude above sea level.

The amendment to the Carey law is contained in the sundry civil appropriation act. It simplifies and makes applicable and practical the original law, which provides for appropriating a million acres to each state, to be selected by the state, and reclaimed through irrigation, for *bona fide* settlers, in tracts not to exceed 160 acres to each owner. Most of the arid states found difficulty under the law as first enacted in securing parties who were willing to advance the capital to construct the necessary canals without security (except the prospect of selling water rights to settlers). Hence, until titles were perfected, investors would constantly fear the absorption of the lands by settlers procuring them direct from the government under homestead and other acts, leaving ditch builders in the lurch. The indefinite language of the original act has made its interpretation by the Interior Department somewhat difficult, and has placed obstacles in the way of states securing the benefits which were originally supposed to be conferred.

A GLANCE OVER THE FIELD.

CALIFORNIA.

A vein of hard coal is reported as found nine miles north of San Jacinto.

The flow from the Eady tunnel near Ontario has been increased from 30 to 35 inches.

Orange county will have a good crop of walnuts this year, a product for which it is becoming famous.

The new cannery at Fresno paid only \$12 a ton for apricots and the farmers kicked vigorously thereat.

River gauges, such as have proved great money-savers in the Sacramento, are to be placed in the San Joaquin river.

The Hermosa Water Company has increased its flow of water six inches, and 5,000 feet of pipe has been put in to carry it to the irrigators.

White men are to be employed in the places of Chinamen in the celery beds of the Santa Ana valley. This is a settlement of a long pending conflict.

The crop of fruit for shipment now promises to be about an average with other years. There are few pears but an abundance of peaches and French prunes.

Quite a number of big hotels have been burned in Southern California within the past three years. Not one of them has been, or is being rebuilt.

A huge fruit distillery is being built in Fresno that will work up a large quantity of this year's crop which would not otherwise find a ready market.

F. M. Smith, of Oakland, claims to have completed negotiations in England for the development of his California borax mines and for the sale of its products.

The new city water system at San Jacinto is reducing the flow of the artesian wells below, upon which Lake View and other localities are dependent for a water supply.

The patronage in sight justified the proprietor of the new Casa Loma hotel, at Redlands, to remain open during the summer, instead of closing as was the original intention.

A gigantic electric company has filed its incorporation papers at Fresno, to develop power in the Sierra Nevadas and transmit it to Stockton—perhaps to San Francisco.

The Fresno Water Company is increasing its water supply by the boring of three additional wells, to accommodate increasing demands and the necessities of the Electric Light Company.

California canned asparagus is winning its way in the eastern markets and commands a ready sale and higher prices than the New Jersey product. It goes to market packed in both tin and glass.

The suit for damages by the Fresno Milling Co., against the Fresno Canal and Irrigation Co., asking damages for interfering with water supply has been decided in favor of the defendants.

This has been the hottest season ever known in the Colorado and Mojave deserts, the mercury ranging for days from 124 to 128 degrees. It is altogether too tropical for comfort.

The farmers near Banning are reported as having adopted a system in the cultivation of their lands which is proving eminently satisfactory. A man having a

hundred acres devoted to grain plants only one-half each year, giving the other half a rest and chance for recuperation. They claim that the crops are so much better the profit resulting is altogether in favor of this plan.

At the convention of orange and lemon growers at Los Angeles it was clearly brought out that the co-operative method of marketing is gaining favor, and it received a practically unanimous endorsement.

The "campaign" at the Chino beet sugar factory opened in the last days of July. There has been a larger planting than ever before and they are preparing for an output of nearly or quite 30,000,000 pounds.

The Southern Pacific Railroad company has purchased thirty-five acres of land near Cucamonga and have opened a granite quarry. The stone is said to be of extra fine quality, and the fragmental rock is to be used for ballast.

The Southern Pacific Railroad company has also purchased ten acres of land in East Riverside, which will afford ample room for the location of packing houses that will soon be needed for handling the crop from the extensive growing orchards.

The state tax levy this year is yielding a large excess of revenue, the governor having vetoed several of the appropriation bills. On the same valuation the rate can be reduced for next year from 65.8 cents to 48.5 cents on the hundred dollars.

San Diego voted by more than a two-thirds majority to issue \$1,500,000 bonds to purchase the Morena water system and to provide for the construction of a new city plant. The opponents immediately sued out an injunction and now the lawyers will have their innings.

John E. Kirk has planted 250 acres of hemp near Gridley and will give it thorough irrigation by pumping from the Feather river. He has the machinery on the ground for a complete hemp mill which will be in readiness by the time the hemp is ready to manufacture.

The Redlands Electric Light Co. is adding a steam plant as protection against accidents. It has been successful in every sense and has secured some very valuable contracts, which do not permit of a single

day of cessation in their performance. They are preparing against possible emergencies. There has never been any shortage of water, in fact there has always been a large surplusage.

This year's frosts have developed a number of thermal belts or districts which were exempt from them. There is such a variety of climate in the state that only the experience of a term of years can finally determine the best adapted localities for specific purposes.

The freight rates that are being established on the Valley road are but little more than half those which have been charged by the Southern Pacific company. Of course they will be met and may be cut to even a lower level than that indicated.

The dry season is proving a blessing in many sections by forcing a search for new water sources. A. B. Smith dug a well near San Dimas depot 35 feet deep which is yielding a large supply of water, steady pumping at the rate of thirty inches not nearly taxing its capacity.

The Colton Fruit Exchange paid its members dividends to the amount of about fifty thousand dollars for the shipments to the end of May. Several car-loads netted from \$800 to \$850 each and two cars of St. Michaels and Valencias sold for a gross amount of over \$1,300 each.

There are said to be more than a thousand bee-keepers in Southern California. Until recently there has been no organization and no means of ascertaining the extent of the product. Last year 7,000,000 pounds were marketed and the business is being extended northward into the San Joaquin valley.

Although the San Jacinto and Pleasant Valley Irrigation district is in the best condition of any in the state, the system is incomplete, and the pending decision of the Supreme Court of the United States as to the constitutionality of the law under which it is organized makes it impossible to dispose of the bonds necessary to its completion.

Judge Van Dyke has rendered a decision in the case of Mayberry against the Alhambra Addition Water Company of more than usual importance. It includes the declaration that developers are entitled to the increased flow of streams, even

after it has apparently passed from their control. The developer has rights that are paramount to the riparian claimant. The court refuses to recognize increased flow as a burden on riparian lands, as long as the accustomed flow is not diminished.

Mr. O. B. Stanton, formerly proprietor of the Baldwin Hotel, San Francisco, has been developing some mining interests in the Mojave desert and has struck a wonderful flow of artesian water near the Koehn postoffice. The well is six inches in diameter and is flowing water enough to run 100 stamps. It is now being utilized to drive a mill about 250 feet distant from it. This discovery is one of great significance in connection with the future development of that valley as to its agricultural and horticultural possibilities.

The San Francisco Wave eloquently discourses on the attractions of California—its ocean and mountains, the Yosemite and orange groves, the redwoods and Del Monte, and claims there is no land under the sun that can rival it either in the grand, the beautiful or the picturesque. Then it compares the commercial value of these with other products and states by way of illustration that New Hampshire plucks eight million dollars a year from the stranger visitor, or more than half as much as the total gold product of California.

The assessed valuation of Stanislaus county this year is \$13,167,459, a decrease from last year of \$1,535,447. It used to be that people were proud of an increase in county and state valuations, but it is so difficult now to pay taxes that they rather enjoy going backward.

The vintage of dry wines for 1895 was only 9,500,000 gallons as against from 15,000,000 to 24,000,000 per year during the past several years. The consumption within the state is about 5,000,000 gallons so that there is but comparatively little left for export this year.

Fresno is especially fortunate this year. The Republican says: "The advent of the Valley road, the introduction of electricity for power and light and the erection of one of the largest wineries in the state, show the great faith that capitalists have in the future of the county." And now there is to be added a large factory for seeding raisins. The machinery to be used has

been tested practically, and one factory is in operation in New York. The capacity at the outset will be two car-loads daily, employing ten machines, and it is expected that an enlargement of the plant will be necessary next year.

COLORADO.

Grasshoppers are causing trouble on the ranges near Golden.

Crops under the Larimer county canal are in splendid condition.

Many cloudbursts, some attended with loss of life, have been special features of this season.

The sheep sheared this year have averaged over seven pounds to the fleece in the dirt.

The apple crop is a little short in the Arkansas valley, about equal in loss to a good thinning. Other crops are up to the average.

There are 85,000 trees being watered under the Price ditch, in the Grand Valley this year, of which 75,000 have been planted this year.

The Farmers' Protective Association, at Evans, has brought suit to recover \$50,000 of damages from the ditch companies on Clear creek for taking water that does not belong to them.

The ranges in southwestern Colorado and northwestern New Mexico have suffered fearfully from drought, and thousands of cattle had to be shipped out to save them from starvation.

The Monte Vista Journal says the losses through shortage of water this year will amount to more than it would cost to build the necessary storage reservoirs on the upper Rio Grande to insure an ample supply at all seasons.

Smith & Struthers have completed their gravity ditch through which they flow the water from Plateau creek, across the Grand river to the plateau above Grand Junction, thereby bringing under cultivation a body of extra choice fruit lands. It will require the balance of the season to fill the ditch with water and get it into good working condition, but it will be ready for full operation next season.

The severity of the drought in some portions of the West is well illustrated in the records of the Poudre river, which have been accurately kept for a number

of years. The average flow for the week ending July 14 was 417 cubic feet per second. In 1895 for the corresponding week it was 1,408 cubic feet, and for twelve years previously the average has been 1,336 feet per second. The lowest record previously was 484 feet in 1888.

The Mancos Times says the drought has given the ranchers a new wrinkle in alfalfa raising. Heretofore they have used too much water, making the ground soft and the roots of the plants so tender that even a light wind would topple over whole fields before it was ready for the mower. Authorities at the State Agricultural College maintain that too much water is ordinarily used, and that the grass should be cut before it has fully blossomed.

IDAHO.

There was an active demand for the Snake river cherry crop, and the harvest was hastened by it.

There is a rock found along the upper Snake river which has been used to some extent for building. When first quarried it is soft and can be sawed into blocks of almost any size with little labor. It is so light that a man can lift a yard cube block of it. It will not stand fire, but it becomes very hard when exposed to the weather. It is of three colors, gray, white and pink.

At Boise, hot artesian water is piped from the foot-hills and is used for heating many of the largest buildings. They are now sinking a well which is down four hundred feet at the government army post, and if they succeed in striking the heavy flow, as anticipated, it will save \$400 a year in fuel. If the post is increased to a regimental headquarters, the saving will amount to over \$10,000 a year.

KANSAS.

The Kaw bottoms, between Lawrence and Kansas City, have 11,000 acres in potatoes this year, with the promise of a splendid crop.

Farmers in the Arkansas valley are suffering loss of crops again this year because of the shortage of water in the river. There can be no effective remedy except to store the flood waters, and the sooner the people get about it the better it will be for them.

Judge Fred Wellhouse, of Leavenworth county, is the most extensive and most successful individual apple grower in the United States. He has 1,360 acres, planted during the past twenty years, and is adding 160 acres this year.

The yield of wheat this year is expected to be about 43,000,000 bushels, or double the crop of last year. The home consumption is supposed to be about 9,000,000 bushels, leaving about 34,000,000 bushels for export, or 10,000,000 more than was exported from the Argentine last year. If it was worth fair prices it would make prosperous times for Kansas. As it is the people will work hard and the railroad companies will reap the principal benefits.

MONTANA.

All crops are fine this year in the western part of the state.

Billings has a new flouring mill of the best modern pattern. It is one of the several recently erected in the state, and all of the same class.

Two men at Terry sheared 462 sheep in three minutes less than ten hours, and won a wager of \$100 that they could turn off four hundred head in that time.

NEBRASKA.

Several thousand car loads of grain from this and adjoining states have already been contracted to go out over the Missouri, Kansas and Texas road via the deep water harbors of the Gulf to New York and Europe.

It is said that P. D. Armour has put an expert buyer in the Omaha market who is buying all the sheep offered of every description, and the query is, what is the significance of it? Armour does very little business for fun.

The Nebraska Farmer claims that the state will have the largest and best crops of all kinds ever grown there, and it proposes to hail the advent of returning prosperity by the issue of a 32-page Stand-up-for-Nebraska edition early in August.

Rapid progress is being made on the Great Eastern canal. It is intended to irrigate 250,000 acres in Nance, Platte and Colfax counties. Five grading machines and fifteen scrapers are at work on the main canal, and five miles are completed.

The power and irrigation canal at Crawford is nearing completion and water has already been turned in. The people of the town are greatly elated over the bright prospects before them and give credit that is due to Mr. Chas. J. Grable, through whose public spirit, energy and perseverance the work has been accomplished under unusual difficulties.

Thousands of wind mills and pumping plants are being erected for the purposes of irrigation. The same outfit provides for many other important purposes. The water may be run through the creamery box, thence through the watering trough in the stock yards, thence to a reservoir where ice may be cut, to another one where fish are grown. Indeed there are many uses to which the same water may be applied before it is finally turned upon the soil.

NEVADA.

People of the Carson Valley are earnestly considering the matter of water storage in that valley, where a large area of choice land can be made available at a moderate expenditure. A series of fourteen small reservoirs is proposed that will cost about \$100,000.

NEW MEXICO.

Wolves are killing many calves in Lincoln county, and the stockmen are rising in arms against them.

Ground has been broken for the Sisters' New Sanitarium and Hospital at Las Vegas. It is under contract, to cost a little more than \$20,000.

Cattle men in the southern part of the territory report the increase this season as better than at any time since the '80's. The outlook for a prosperous year is very bright.

M. W. Mills, the pioneer orchardist of Colfax county, is erecting a canning and preserving factory to utilize great quantities of fruit that he cannot afford to haul thirty miles to market. It will have a complete modern equipment of machinery.

The Pecos Valley people have acted wisely in securing the advice of experienced men for the beet growers in that valley. Mr. Austin, who as superintendent of the farm operations for the Lehi, Utah, company was down there for three or four weeks. No better adviser could well be

found if success for a term of years counts in a man's favor. He was followed by Mr. M. E. Johnson, of Chino, California, another recognized expert.

The capital having been raised for the construction of a great reservoir on the Rio Grande river, above Rincon, and a system of canals for all the valley including the cultivated lands in Mexico below El Paso, it is thought there will be no occasion to construct the proposed international dam. The new company will furnish the Mexican people with water on better terms than they expected to get it from the government project, and it saves from overflow a large body of choice lands that can be utilized for cultivation and that will be immensely enhanced in value.

The wool growers' convention at Las Vegas formulated a report with accompanying resolutions, in which it is claimed that since 1890, under existing legislation, the average value of sheep has been reduced from \$2.66 to about \$1.00 a head and the price of wool has been lowered as much as 60 per cent., so that the loss in both wool and sheep has been about two-thirds the former value. For the fiscal year ending June 30, 1894, the wool crop was about \$3,000,000 in value, while for the fiscal year of 1896 it is not more than \$500,000. The loss resulting to the territory from the present tariff act has been \$6,000,000 in the value of the sheep and an annual income of \$2,500,000 in the wool product. Naturally they are interested to have a change in the legislation which produces such results.

NORTH DAKOTA.

Hon. Walter Muir expresses the opinion that wheat will not average nine bushels to the acre in this state.

An artesian well on the Howard farm, near Forman has been finished, 880 feet in depth. It throws a $4\frac{1}{2}$ inch stream of water 16 feet in the air and has a pressure of 125 pounds to the square inch.

The Northwestern Farmers' Protective association acknowledges failure to accomplish its purpose and has decided to dissolve the organization. It will require an assessment of 25 per cent. on the stock to pay the indebtedness.

OREGON.

The Albany creamery was compelled to decline an order for 8,000 pounds of but-

ter, having orders in hand for 21,000 pounds not yet filled.

SOUTH DAKOTA.

J. G. Bullen of Ashton, South Dakota, has an artesian well flowing 600 gallons a minute. It is about 1,000 feet deep and cost less than \$1,000. The water will be used to irrigate a large area of ground.

The successful operation of the Hunter farm at Mellette is proving a very great object lesson to those interested in irrigation and as a result a large number of farmers have been irrigating this year, and next year the farmers who depend on rainfall will be in the minority.

UTAH.

Kaysville has completed its second reservoir, holding 10,000,000 gallons.

A heavy cloudburst at Mercur, July 7th, did considerable damage, washing out the streets and flooding the store rooms.

The state will soon receive \$22,000 from the general government to go to the fund for the College of Agriculture and Mechanic Arts, the amount having already been audited.

Out of the appropriations for surveys made by the recent Congress the U. S. Surveyor General for Utah will have \$20,000 at his disposal for surveys of agricultural and grazing lands within the state, and he has called for applications for survey from the citizens so as to use it to best advantage.

The survey of Gunnison Island in the Great Salt Lake has been approved by the commissioner of the general land office, and a plat has been filed by the Surveyor General in the land office at Salt Lake City. It is said some portions of the island are very desirable.

A suit which will raise the question of priority of water rights on the Provo has just been begun by way of injunction against the people near Woodland, who have been using during the past six years a full water supply without regard to the claims of the Wasatch and other companies above them, which were first established. There will be a bitter contest, as there are important fundamental questions involved.

WASHINGTON.

Great crops and lots of work to do, but low prices yield little return for the labor.

The Spokane Chronicle don't want to see the state crowded in European fashion, but thinks there is ample room for 200,000 more people with some money and lots of hustle.

Chinese thistles are getting too much of a foothold in and around Spokane. People are too busy talking politics to devote time for their extermination.

WYOMING.

The lamb crop is unusually good this year.

Big Horn county was formally organized July 6.

The first pot of cement was calcined at the new works at Laramie early in July. It is pronounced to be of very superior quality.

Robert Taylor, of Caspar, has a wool clip this year of 560,000 pounds. He is supposed to be the largest individual wool grower in the country.

The Rock Creek coal mine owners are trying to induce the government to purchase its supply of coal for the Pacific coast coaling stations, instead of going to British Columbia for it.

Cloud-bursts, several in succession, have so damaged the Brockway ditch, near Douglas, that it may have to be abandoned for the year. A soaking rain soon afterward saved the crops from total destruction.

The largest sale of state lands yet made was at Evanston recently when lands which have been occupied several years under lease were sold at auction to the occupants for an aggregate sum of \$4,335, which goes to the state school fund.

Some mischievous or malicious person cut the locks on the headgates of the new Cody canal in the Big Horn basin, raised the headgates and let a big head of water into the canal, which was not yet well set and ready for it. A break was the direct consequence and a great deal of damage to farms below the canal.

One geological survey party has left Sheridan to triangulate across the Big Horn range into the basin, and another party left simultaneously from Red Lodge, Montana, carrying levels into the same basin and prepared to make a thorough topographical survey, the two parties co-operating. It will materially

assist the settlement of that great basin of rich land in Northern Wyoming.

AN ERROR.

In Mr. C. C. Hutchinsons' article on "Growing Winter Grain", in the July number there is reference to his work entitled "Resources of Kansas, or Fifteen years experience." A typographical error made this appear as though published in 1891. The correct date is 1871 which is twenty years earlier. Mr. Hutchinson was one of the very earliest of Kansas pioneers and the thriving city of Hutchinson was named in his honor.

PRACTICAL POINTS.

Clean out your granaries and destroy the vermin of every kind before putting in new grain.

Sheep and fowls are the gleaners of the modern farm; they save much that would be wasted without them.

A hen that does not work for a living never amounts to much, no more than a man.

Motherhood in its largest development is the object sought in the profitable dairy cow.

Because poor cows will yield no profit is no reason why good cows will not pay.

Pure water is as important as pure food to any kind of live stock.

Nothing on the farm should be under so complete subjection as the weeds.

There is less danger of producing things too good than not good enough.

It is claimed that cows with thick udders usually give rich milk.

Hay is most nutritious as feed when cut before the seed begins to ripen.

Breed for heavy weights in horses, no matter if a ton.

A change of food is sometimes better than more food.

It is as unprofitable to feed too much as too little.

It is pigs that are wanted in the markets now—not hogs.

You must begin in the stable to make good butter.

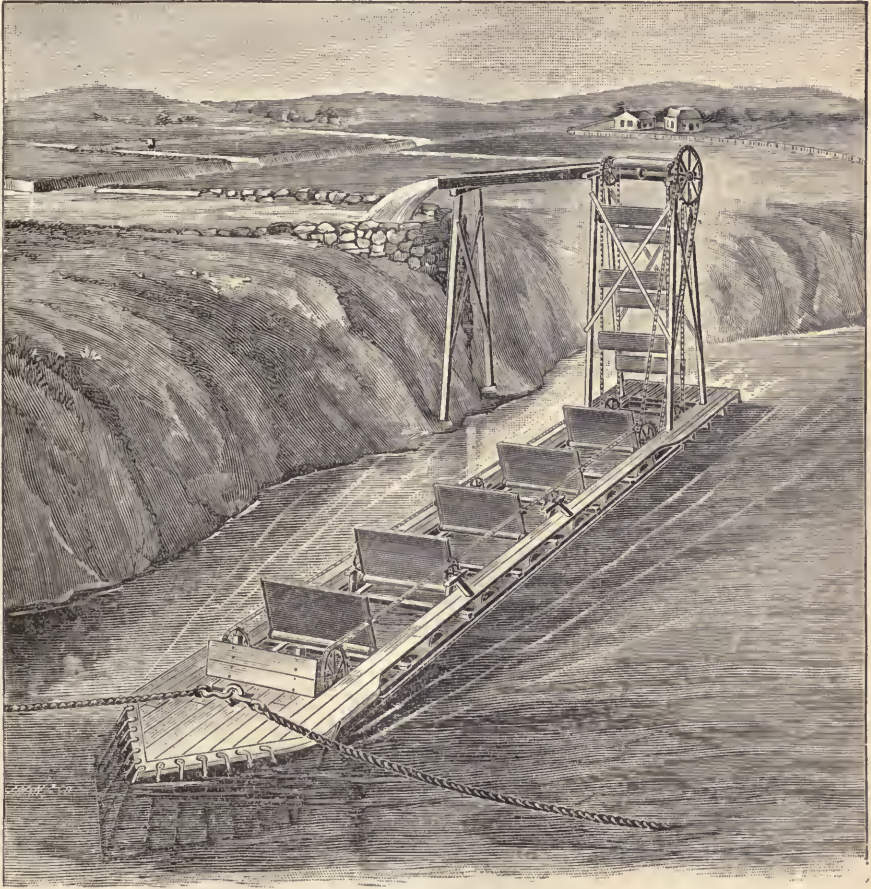
Feed, as well as breed, is necessary to dairy success.

MACHINERY AND APPLIANCES

THE AUSTIN CURRENT MOTOR.

THE name "Current Motor" is applied to a mechanism that utilizes the power of the stream or current of a river in such a way that it can be applied to operate machinery. Several crude attempts have been made in the past to accomplish this,

the construction and maintenance of the dam, and was only available where the conditions were favorable, which necessarily very much limited their use. The current motor, however, can be used without a dam, in any river, in any location in the river where the water is deep enough to admit it.



AUSTIN CURRENT MOTOR.

and the F. C. Austin Manufacturing Company, fully appreciating the advantages and possibilities of generating power so cheaply, have invented and placed on the market a practical current motor.

Rivers have been utilized to run machinery by damming them and using a water wheel, but this necessitated the expense of

There is almost no limit to the use to which the power generated by a current motor can be applied. For example, it may be used for generating electricity for electric lighting purposes, and for various machines used on a farm now run by steam, but its chief use will be in connection with irrigation and mining.

There are many localities in the West, and in fact all over the country, where the land adjacent to the river is too high to admit of the water being conveyed to it through ditches by means of gravity. Under such conditions the land is now generally not irrigated, particularly in the arid regions, except to a limited extent in those localities where vegetables and fruit are raised, where the value of the crop compensates, in a measure, for the expense of pumping water by steam or gasoline engine, both of which require fuel and an engineer. The capacity of the windmill is too limited to admit of its general use for irrigation on a large scale. To such localities the Austin Current Motor will prove a boon.

This motor has been experimented with and tested thoroughly and its practicability practically demonstrated. The only limits to the power, and consequently to the amount of water that can be pumped by the Austin Current Motor, are the dimensions of the paddles, the number of them and the force of the current.

The machine, which is anchored in the river, consists of a pontoon carrying two endless chains, to which are pivotally attached, at suitable distances, reversible paddles having floats at their upper ends that buoy them up in their course through the water. By an ingenious device these paddles enter and leave the water in such a way that they do not detract from the efficiency of the machinery, but on the contrary rather add to it. To the wheels put in motion by these cables is attached an elevator carrying large buckets, which, when entering the water to fill themselves, add to the generation of power, and are so arranged that when they reach the top of the elevator they discharge their contents with the least possible friction into a trough, there to be conveyed to the shore, where a reservoir has been constructed to collect the water and distribute it through canals and lateral ditches over the land.

The first outlay for a current motor of this description is, comparatively speaking, not large, particularly when the enormous enhancement of the value of the land is considered, and the cost of running it is nominal. It works incessantly, day and night, without an attendant, and if the capacity of the reservoir is sufficient, a large volume of water is accumulated to be used at the proper season.

For full particulars, write to the manufacturers, the F. C. Austin Manufacturing Company, of Chicago, Ill., U. S. A.

LAND GRADING.

The Shuart Land Grader, the cut of which in our advertising columns has become so familiar to the readers of the *Age*, is eliciting much hearty and enthusiastic praise from a widely scattered and diversified class of patrons. The accuracy and economy with which grading for irrigation can be accomplished with this machine is a happy surprise to each new purchaser.

The Shuart Grader has come to be recognized in the East as exceedingly convenient and useful for road and street purposes. In this sphere it is designed to supplement rather than to supplant the big road machines in general use, and so popular is it for this purpose that it is being purchased by townships in numbers varying from a single machine to one machine for each road district in the township.

In no sphere has its success been more marked, however, than in the preparation of the sub-grade of streets for pavement. Hitherto this work has been done by hand labor with picks and shovels, at great expense, as there has been no scraper made with which the sub-soil could be planed down with sufficient accuracy. The following testimonial, which is by no means an unusual one, shows the great value of this machine to street contractors:

COLUMBUS, Ohio, June 6, 1896.

B. F. Shuart, Oberlin, Ohio.

DEAR SIR: We beg leave to testify to the merit of your Shuart Land Grader. It has more than saved its price within the first four days' work, having used it on the finished sub-grade, in which capacity it has each day saved the expense of from ten to twenty men, with just the same or better results. We find it extremely handy and useful.

Very truly,

KINNEAR & GRAHAM.

Important improvements have recently been added to the machine.

In 1895 there were eight hundred and fifty-five creameries in Iowa. Only four of the ninety-nine counties have none. The total output was \$13,300,000, an average per factory of \$15,555.

THE IRRIGATION AGE.

VOL. X.

CHICAGO, SEPTEMBER, 1896.

NO. 3.

PUBLIC OPINION AND THE IRRIGATION CONGRESS.

NO one more fully appreciates the attitude of THE IRRIGATION AGE toward the great question of reclamation of the arid lands of the West than I do. THE AGE, ever since its birth, has advocated a national policy broad enough to include plans for the reclamation of our arid plains as well as the uplifting of humanity at large. The policy advocated has been too broad, too generous, and therefore impracticable. This work, I believe, is too great for our civilization; our institutions are too corrupt. At present they will not aid us to take up this work in the most local manner.

There seems to be an invisible but all-powerful force at work whose sole purpose is to defeat any and every measure which has for its object the "greatest good for the greatest number." "Private enterprise" must not be discouraged, even if it is busy in the work of overthrowing our republic.

At times during the past five years our unemployed have numbered millions. The misery of the poor in our cities surpasses that of Europe's most degraded. A Medici could not have been more corrupt than the heads of some of our own city governments. We are taxed to build battle ships at a time when the whole world never had better reasons for maintaining peace, and the price paid for one such battle ship would, if expended in watering lands of the West, provide homes for a hundred thousand people. When Congress, like the press, is the mouthpiece of corporations and trusts; when the people are taught that "paternalism," or the public ownership or control of monopolies, threatens the liberty of the nation, and that private ownership of the planet itself

is preferable; when we, with all our boasted facilities for the expression of the will of the people, are a quarter of a century behind civilized Europe in modern reform, we have but little reason to expect the federal government to aid in any work which might carry with it a blessing to humanity.

Let us turn from the impossible chances of federal aid to opportunities of taking a step forward through state influence. The people of this state (Idaho) are preparing for a contest to be settled in November. For what purpose? For the inauguration of some prearranged state policy of development? for the strengthening and building up of state institutions? We have not had a state policy outlined for years. This contest is being entered into simply for office. The old parties are now torn into factions, and men, through their partisan zeal, have lost sight of the state with its future. This occurs periodically, and the meetings of our legislatures are remembered as marking the disgusting contests for public office. The event of a session is the election of a United States Senator; all other acts are subordinated to this great undertaking, for which preparation is begun at the people's primaries, and work prosecuted to the detriment of all needed legislation through the "trades," "compromises" and "combinations" made by members, until worn out or bought out, a small faction gives in, and the greatest of all the gifts of the people, next to the presidency, is won by a man who had the ability to "get there," and the legislature adjourns. We have reached a condition where a good, clean, honest government would be an innovation.

Those who *will* think, believe we are now

feeling the first pulsations of a great national upheaval. We know that all appeals for national aid in the work of reclaiming arid lands fall upon deaf ears. Our state legislature cannot be induced to pass a sensible resolution on the subject, so absorbed are they in the welfare of men ambitious for national honors. I feel safe in predicting that for the present nothing will be done by either state or nation in this matter. Let us wait until our present pressing troubles have been overcome, until the great period of reconstruction is upon us, then we may inaugurate a policy of development as broad and generous to the masses as that pursued by the Incas of Peru. *We are barbarians!*

Just now we have thousands of acres already watered crying for occupants, we have, as have other states, plenty of broken down irrigation companies, and under the present disorganized condition of public affairs I neither hope nor care to see the prosecution of new enterprises until the ones already perfected are upon a paying basis, and under every canal a contented and prosperous community.

The Irrigation Congress of the future, in order that it may be a potent factor in the work of reclamation of arid lands, must direct itself to *state* issues, for through the example and influence of the "arid states" will follow all *national* aid and blessings.

Why should we ask Congress to do more than *we* are doing? We, who have been on the ground for years and appreciate the importance of the work and the great blessings which would be sure to follow the development proposed.

We should all pray God that the rotten methods of administration, that the spirit of corruption which seems to pervade the very sanctuary, the place where law is given birth, might have passed away, and that a broad, generous public policy, embracing the best interests of the *common people*, might be the order of the day before the great rivers of the West are poured out upon the deserts and started upon the work of *redeeming more bonds*.

Before these great canals are built by the national government our national policy will have undergone a complete change, for the work of building must go hand in hand with the work of relieving suffering humanity. These canals must belong to the people *who use them*, and under them millions will find homes, and the work,

when completed, will stand as the greatest monument to an enlightened nation.

An enduring monument must have a broad base and a firm foundation. We must therefore first clear away the prejudices of the times due to past errors, dig through the rottenness of to-day down to the first principles of sound government, and upon this foundation, and this alone, erect a structure from whose highest pinnacle prosperity shall proclaim peace and happiness to all who labor in the sunny "arid West."

D. W. Ross.

Payette, Idaho, August, 1896.

NONE of us have any time to cavil or complain over what has been done or has not been done by any member of the association. There is no time for any paper or magazine to criticise others or their work in the cause.

We are all for the same objects and it matters not whether we be the "hare or the turtle in the race." Both will get there just the same. The slow turtle may be the quicker because it does not stop to see or ask what others are doing.

It is not the breezy, gauzy, voluminous continued articles that are always appearing in the press, to the satisfaction of the writer and to the great disgust of the public, that do much good.

The members of the executive committee of the National Irrigation Congress are, and will continue, doing their duty, notwithstanding any remarks to the contrary. They are men of ability and are practical, energetic, pushing business men who believe that there is a time and place for all things, and when the time comes for each to push it to the front they will with all the manly vigor and strength and power within them, making a complete success of it; not consuming too much time in its development but just enough to keep the anxious public on tip-toe as to what comes next. They believe that in direct, continued and united effort, more can be accomplished in three months' time before the congress than to string it out in a flimsy way for twelve months.

The work of the committee this year will be found as great as any other year—wait and see!

It is true that not many conventions have been held and especially in the

northwest (have there ever been any that the National Congress called through its executive committee?), simply because there were no funds. And the committee soon found that there would be none or would be very small if any. For those who had given as individuals or corporations wanted an accounting of it before more would be contributed. Again it has been and is the dearest year that this country has seen since the war, so much so that it has not only paralyzed business of all kinds, but it stupefied the people and produced that "don't care" way about them that no one or ones could arouse that enthusiasm that is needed in all meetings of this sort. The fact is, the people don't care about so many meetings. They know what irrigation means. They feel the need of applying it and many are applying it to their needs. What they want is the enactment of proper laws for the distribution and use of water, for the greater development of the arid and semi-arid west, in such ways and by such means as mainly will be expressed and determined upon by this coming Congress. They will formulate these into bills that will be presented to the next congress of the United States for passage. Now, what bills do you want to pass upon? This is the main question! Let every one in every state and territory interested in this great cause, express himself through the columns of *THE IRRIGATION AGE*, and come prepared with his bill ready for consideration before the next Congress. In other words, let us resolute less and legislate more. Let us definitely decide upon what we want as a Congress and then press forward to its accomplishment. Let us depend less upon committees to do this work that must be done by the Congress. For four years we have talked and resolute, held meetings and been entertained by the brainest men in the work, have been benefitted in many ways as an individual, toasted and banqueted from place to place and from coast to coast. Now let us boil down, crush out and wash out all the dross and crystallize all the bright practical thoughts and sayings into bills that will be of permanent good to the cause of irrigation and finally the country we seek to benefit.

Now, you want to know what has been done by the committee, and what we think should be done at the next Congress? You

shall know, if from now on to the meeting of the next congress, you watch the papers and read what is said about irrigation and the Congress at Phoenix.

E. R. MOSES,
Chairman National Executive Com.
Great Bend, Kan., Sept. 7, 1896.

AS a member of the Fourth Irrigation Congress, at Albuquerque, N. M., in 1895, I am clearly of the opinion, from experience gained at that session, that the work of the coming Congress to be held at Phoenix, Arizona, next December, should be outlined by the executive committee and by our irrigation publications. It is not saying that in the past the work was not outlined, writers and speakers notified to be prepared on certain subjects, etc., just as is now suggested by the present executive committee, but what we now desire to call special attention to, is to prepare the Congress for vigorous and telling legislation upon the practical propositions that will come before it. In the various "Addresses to the Country," as adopted by each Congress, now for four years, we have asked for "legislation suited to the peculiar needs of this (arid) imperial domain." We have declared "that it should be the policy of our National Congress to frame laws which will enable the people to obtain possession of the arid public lands." We have asked for "forest reservations; for the education of skilled foresters; for the application of the 'Carey Act,' to various states and territories." We have asked for legislation and the appointment of commissions looking to the adjustment of the difficulties arising out of the waters of interstate and international streams.

As we have done all this; resolved, declared, and demanded, the interrogation will be put—What can we do? That is the question. What can we do as a convention, formed, as this Congress will be of representative, practical irrigationists, representing the most prominent and important industry now before us as a great nation, with thousands of families in our great cities and centers of population, destitute, and demanding the opportunity of making a livelihood. We have millions of acres of as rich and productive soil as the prairies of Illinois or Iowa can boast of, now lying idle, in what is called arid

wastes of the middle west. Contiguous, and available to these same arid lands, are cachement basins and reservoir sites capable of impounding the summer rains and winter snows which a kind Providence sends upon the just and unjust alike, sufficient for the thorough irrigation and reclamation of these lands. Many of these reservoir sites have been located by the government under act of congress of Oct. 2, 1888.

We have asked the general government to appropriate money and appoint commissions, and under their supervision, to expend this money so appropriated, to make available these reservoir reservations. We have represented, that by this course thousands of happy homes will be made on what are now desert wastes, inhabited only by the rodent and the reptile. To all of these reasonable demands, the national congress has paid no attention. By recent decisions of the Interior Department, the act of March 3, 1891, relating to reservoir reservations, has been declared defective and inoperative, so that these reservations cannot be utilized as was intended, and therefore these waters are running to waste, creating floods and inundations in the settled valleys below, and the lands which should receive the benefit are still waste places. As the general government does not show a disposition to put into operation the laws now enacted and make available these reservations, let the coming session of the Irrigation Congress recommend that these reservoir reservations, segregated and set aside by Act of Oct. 2, 1888, be turned over to individuals, companies or corporations, under the proper restrictions, who will submit plans of their proposed work, and who will put in the necessary capital to impound these waters and subserve the general purpose for which these segregations were made, and thus carry out the real intent of the government. Private capital is abundant and anxious for good investments. Irrigation enterprises, based upon sufficient water and good land upon which the water can be placed, are considered good investments. The "dog in the manger" principle, upon which these reservoir reservations are now held by the general government, is working untold injury to thousands of people who make up our best communities and who, if opportunity was offered, would settle upon our desert lands, build school

houses, churches, and erect happy homes.

Should our national congress take this view of the present situation of these reservations, private capital will set the initiative, construct reservoirs upon certain of them, thereby illustrating in an object lesson the feasibility of the enterprises, after which, when the government gets ready to act, the remaining reservations can be withdrawn and the proper authority take it up.

This character of work appears to me to answer the query at the head of this article. There are other equally good propositions which might be enumerated for the coming Congress, but I fear I have already too far trespassed upon your space to give them this time. I will only add, that our experience shows the necessity of immediate practical national legislation to redeem our arid lands and give an impetus to the agricultural interests of the great middle west of greater importance to us than the great question of 16 to 1 now so much agitated.

J. S. VAN DOREN,
Bluewater, N. M., Sept., 1896.

I AM, after an experience of eleven years on this portion of the American Desert, convinced that the land laws governing the settlement of the Mississippi valley, ought not to apply here. I am sure that if settlers could have taken 640 acres each on long time, at say, 3 per cent. interest, we would have a considerable population now, if the pre-emptors had had ten to twenty years to pay in and no proving up and mortgaging in less time.

I am in favor of a classification of the western lands into first, second and third class irrigable, owing to their fertility and ease of irrigation, and the non-irrigable classed same way, their value being settled by their grazing value. The taker of an irrigable claim to have a dry section or two as well.

The object being to give men land enough to make a living on and acquire it at a low price, on long time and low interest. Better give the public lands to the states as they are admitted to be states. Secondly, I decidedly favor the opening of the Indian reservations, providing bountifully for each Indian family in land. Thirdly, If the lands cannot be turned

over to the states, I decidedly favor the extension of the Carey law to all states and territories in the arid regions. I also think it entirely proper that the government should return a good share of the money collected from the deluded settlers west of the 98th meridian. This money to be used in surveying and building reservoirs and otherwise aiding irrigation. With the exception of small sections here and there, all of this great territory in the arid region is better adapted for stock purposes than anything else. And the most of the irrigation in a vast deal of this region will be done to raise crops to safely carry on the stock business, as an aid to it.

We have our regions specially adapted to some one thing. Louisiana for sugar, the South generally for cotton, the Mississippi and Missouri valleys for corn, the Northwest for wheat, and, as our population increases, this region will be one vast grazing ground for cattle and sheep. Laws should be made, placing these lands in the hands of the people, having in view the uses it can be best put to. And who can make such laws better than the men living in the states of the arid region. So let the government go out of the land business and by so doing these new states can lease their unsold lands and thus benefit their public schools and mature plans on the ground for the building of canals and reservoirs, and I believe a vast growth of population and increase in wealth would result, in much shorter time than if this region is dominated by land laws, made by eastern men unfamiliar with our conditions.

C. D. PERRY.

Englewood, Kans., Aug., 1896.

I AM in favor of the repeal of the desert land laws. I am not in favor of opening the Indian reservations at present. I think it would be but justice to the territories to give them the benefit of the Carey law. Government reservations ought to be given, leased or sold to parties who will make the best possible use of them for the public, if the government will not make use of them itself.

I approve of the government making speedy surveys of available water supply for irrigation and the construction of storage reservoirs. The matter of state laws to protect actual settlers and to prevent dishonest bonding was very generally discussed at both the National Irrigation

Congresses I attended and resulted mainly in developing the fact that there were as many different views upon the subject as there were speakers. It is a vexed question under our present system of governmental management of waters. I know of no system that meets my views equal to that in use in Canada. The more I study the question of irrigation the more I am convinced of two facts. First, that our government is neglecting one of its best opportunities to build a republic that will be as enduring as time. Second, that we have no statesmen to-day of a broad, far-reaching, comprehensive character and ability to grasp and carry on this work.

A. L. KELLOGG.

Rocky Ford, Colo., Aug., 1896.

THE government should exercise the same care and prudence in the disposal of its domain as would a private individual. The government has no moral right to dispose of public property by gift to private individuals, while, unfortunately it has the power.

The importance of proper construction of dams to make reservoirs is so great that it should be undertaken by the government only, while the users of the water from such reservoirs should be required to pay such charges as might seem proper, so that the investment of public moneys should be made revenue producing.

No bonding schemes of any sort, no investments of private capital in irrigation works of a general character should be permitted under any circumstances.

The desperate financial condition of our people is due to a large extent to the enormous interest charges that we are carrying and every man who has the interest of his country at heart, should frown on all efforts at extensions of this most pernicious system.

GEO. M. MUNGER.

Eureka, Kans., Aug., 1896.

I FEEL that we are not at present needing more land opened to settlement; that the government after selling land to innocent purchasers and representing it as a place to make a home and furnishing nothing but the most meagre information concerning it, owes to its subjects a full, careful survey that will disclose accurately all its possibilities and advantages.

J. S. BARNES.

Pratt, Kans., Aug., 1896.

The Fifth National Irrigation Congress

To the People of the United States of America:

Pursuant to the order of the Fourth Irrigation Congress and to designation by the National Executive Committee, the Fifth Annual Session of the National Irrigation Congress will be held in the City of Phoenix, Arizona, upon the dates of December 15, 16 and 17, 1896.

The membership of the body will be made up as follows, in accordance with the resolutions of the Third and Fourth Congresses:

BASIS OF REPRESENTATION.

1. All members of the National Executive Committee.
2. All members of State and Territorial Irrigation Commissions.
3. Five delegates at large, to be appointed by their respective Governors, for each of the following States and Territories: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming.
4. Three delegates at large for each State and Territory not heretofore enumerated, to be appointed by the Governors of said States and Territories; or, in the case of the District of Columbia, by the President.
5. One delegate each from regularly organized Irrigation, Agricultural, and Horticultural Societies, and Societies of Engineers, Irrigation Companies, Agricultural Colleges, and commercial bodies, such as Boards of Trade, Chambers of Commerce, etc.
6. Duly accredited representatives of any foreign nation or colony, each member of the United States Senate and House of Representatives, and each Governor of a State or Territory will be admitted as honorary members.

THE WORK OF THE IRRIGATION CONGRESS.

The work of the National Irrigation Congress has now continued for more than five years. The first session was held in the City of Salt Lake, Utah; the second in Los Angeles, California; the third in Denver, Colorado; and the fourth in Albuquerque, New Mexico. Each session was marked by keen interest and by intelligent and effective work in the cause of irrigation and the reclamation of the arid lands of the West.

THE FIFTH ANNUAL SESSION.

The coming session at Phoenix will, it is not doubted, be the most effective of all. Particularly prominent will be made the discussion of points of legislation in order that well-digested measures be prepared for the consideration of the Federal Congress and of the State Legislatures. Though able authorities will be in attendance and have been placed upon the programme for the presentation of subjects of technical and economic interest, it is designed that the Fifth Congress shall be a body with work far more general than has been the case in any of its predecessors. Addresses presenting subjects shall be limited to fifteen minutes, and the subsequent discussion to half an hour, this ruling of the Executive Committee not applying, however, to the discussion of legislation or resolutions.

PHOENIX AND ITS ENVIRONMENT.

The City of Phoenix, chosen for the location of the Fifth Congress, is in every way well adapted. It is a thrifty and progressive city of 12,000 inhabitants, the capital of the Territory of Arizona, and is excellently well prepared for the reception of even the thousands who will come to attend the Congress. Its local committee of arrangements and reception is already at work, and the promise is extended that every visitor will be furnished with the best of accommodations at prices even lower than usually charged locally. Ample opportunity will be afforded delegates to inspect all points of interest without cost.

Railroad rates will not exceed a single fare for the round trip from all points between Chicago and the Pacific ocean; details of transportation and ticket limitations to be later announced by the interested railroads. Passengers may be routed into Phoenix over either the Santa Fe or Southern Pacific railway systems. Opportunity at low cost will be given for side trips to the Grand Cañon of the Colorado, to the City of Mexico, to Southern California and other points.

E. R. MOSES,

Chairman National Executive Committee, GREAT BEND, KANSAS.

THE ART OF IRRIGATION.

CHAPTER XV. IRRIGATING ONLY A PART OF THE GROUND.

THE PROPER USE OF BASINS.

BY T. S. VAN DYKE.

WHERE the supply is sufficient the whole ground should generally be wet at each application of the water. Especially is this the case in the arid countries, and the shorter the rainfall the greater the necessity for all valuable crops. But in sections generally having enough rain in the growing season, and only occasionally short or not coming at just the right time, such full irrigation is not always necessary and in many cases would be needlessly expensive. The same is the case with many regions where the ground is thoroughly soaked with rain in winter and the subsoil is porous yet so retentive of moisture that it holds almost enough to carry vegetation through and it only needs a little helping out. The former is the case in most of the country east of the Rocky Mountain slopes, and the latter on the greater part of the Pacific slope.

In such cases the principal suffering of plants is for water to transpire or evaporate through the leaves, most of the ground being still moist enough to allow the roots to feed. But laboring vegetation must evaporate water from its lungs and skin the same as a laboring man or it cannot do full work, and a crop of high grade produce like fruit may be sadly shortened by the failure to supply water at the right time. But to supply it, it may not be necessary to wet the whole ground.

LIMITED WATER SUPPLY.

Limited irrigation is often required by the nature of the water supply. Perhaps you can get it only in a small stream flowing continuously or nearly so and you find a reservoir to store it long enough to give a good irrigating head more costly than your work will justify. This will often be the case where you are dependent on a small spring or a windmill, horse-power or other means of lifting water from a

well that is fed only by slow seepage and becomes quickly exhausted under a heavy and continuous draft, as is the case with most farm wells. And even under a ditch there may be so many critical times when you cannot get head enough, or for a long enough time, that you may be compelled to water only a portion of the ground.

The objections to this method have been sufficiently detailed in the history of the errors of early irrigators in Chapter IV. of this work. But it is objectionable only when one can just as well do something better. Where it is the best that can be done it generally surpasses no irrigation so far that it is highly respectable. It is available only in those places where considerable can be grown without any irrigation. On pure desert it will rarely do and can never be relied on for anything of much value where the ground, including subsoil, does not in some way get a thorough soaking at least once a year. Otherwise the dry ground around the limited basins or furrows saps the moisture from the watered portion so fast that unless irrigated every few days the ground around the roots cannot be kept in the proper state of moisture. And at any time a little forgetfulness or lack of care is liable to do damage that cannot be repaired that season. As a rule it should not be used for trees or vines carrying crops of value unless they will live in that place by cultivation alone without any irrigation. If demanded for the life of the tree, basins are generally too unsafe a way of supplying water.

GOOD JUDGMENT NEEDED.

The first thing to be done by one who finds he cannot irrigate the whole ground is to learn what kinds of vegetation require the most water and what the least, with the intermediate classes, and also

what will suffer the greatest loss if it fails to get water at the proper time.

The difference between the orange and the lemon is a good study, for it represents a difference that exists more or less between all kinds of vegetation.

Either tree worked to full capacity for the largest and most uniform yield of first-class fruit demands more water than any other tree grown for profit in the United States. Yet either will live for months and even years in ground and air dry enough to kill almost any of the forest trees of the Atlantic States in a few weeks. I see daily (in Los Angeles, Cal.), and can see out of my window now as I write, lemon and orange trees living and bearing this 26th day of December that since the last rain, in April last, have not had a drop of water from any source, stand in hard, uncultivated ground and are utterly neglected. And the entire rainfall of the preceding winter was but sixteen inches, and that of the winter before but nine.

QUALITY AND QUANTITY.

So far both are alike. But now comes a very important distinction. With the orange in California neglect of any kind shows itself immediately in the *quality* of the fruit. You may have a tree well loaded without an orange on it fit to eat. And when you come to market the crop you may find it a dead loss. For the oranges on the trees above mentioned you could not get a cent a box from any one. But the lemon will generally show neglect only in the *amount* of the crop and the size of the tree. The flavor of the lemons on a neglected tree will differ little if any from those on a tree well cared for. And if properly cured they will be about as juicy for their size. They will be smaller than on a well tended tree, but then size in a lemon is not as material as it is in case of the orange. In fact the market does not want lemons too large. Consequently you may have crops of lemons that are very profitable from trees that would bankrupt you if they were oranges, a difference very plainly seen in many parts of Southern California.

The same difference is seen in many other things, and though it may be less in degree is none the less worthy of consideration in deciding what you will plant under a water system that is not quite as

perfect as it should be. The English walnut will live in almost as dry ground as the almond, but the meat of the nuts will be shriveled, and one side often lacking entirely, while the almonds will be as solid as ever and merely reduced in size to a point little affecting the market value. The oil olive, the only olive eaten in Europe, is not perceptibly affected in quality by suffering from water and the difference is only in the yield, while the big, insipid olive grown to sell to green-horns who buy for size and color and eat it for style will be a failure for lack of attractive size. The flavor of a peach is much more easily damaged by shortage of water than that of an apricot, while the latter ripens so much earlier than most varieties of the peach that there is little danger of being caught in a spell of the very hot weather that makes fruit suffer very quickly if not given enough drink. Runty grapes are generally fair in flavor and are generally more valuable for wine than if made big with water, but runty cherries will make even a well-bred hog mad. Scrubby apples will make good cider and do to bake or cook, but scrubby plums are an abomination, and abortive nectarines are unutterably vile.

VEGETABLES.

There are similar differences in vegetables. You may be very stingy of water to your tomatoes before they seem to suffer and when they do they will only be smaller, more watery and not so good to eat raw. But the flavor will be little impaired, if at all, and for cooking you may see the difference. But you cannot stint celery in the least if you want to sell it, and unless it has plenty of water you will want little of it yourself. Nubbins of sweet corn still taste pretty well and potatoes may be reduced considerably by drouth and still be mealy. But don't try the same experiment with egg-plant or cucumbers. Pumpkins and squashes will generally show the difference in amount of water only in size, but if melons lack the right quantity they will be flat and often sour. These differences are too extensive for further discussion here, but those given will serve as guides for farther study. You can soon learn what things in your locality and on your soil suffer the least under bad treatment and if you are compelled to limit your irrigation in any

way plant those things and leave the raising of more delicate stuff to those more fortunate in water supply.

LIMITED IRRIGATION METHODS.

Irrigation of this limited form is very simple. The commonest form is limited flooding by means of basins. Some make them square, some oblong, some round, the shape often varying to the slope of ground. The size varies according to the age of the tree or vine and the water supply and the way of delivering it. In some places the area thus wet is nearly one-half the whole ground, in others not a tenth. Where you have a head of several inches of water you may make them large, but if you try to fill large basins with a small head you will wish you had snublet the job. It will be still worse if you are using a water cart or barrel on a sled, a method you had better always avoid, though there are times and places where it will pay very well to help out something. I have many a time seen an orchard in the east where the crop was a total failure but could have been made quite profitable by a few days' work with the sled and barrel at the right time. But instead of relying on such things you will do better to go where you don't need them.

It is best to feed these basins from a furrow running along the upper side and so arranged that when one is full the water will pass to the next. Otherwise you may injure your ribs leaning on your hoe too much. Grading of the ground is not so essential with this method as with the others, and basins are often used because ground is too rough grade for the other methods, yet not valuable enough to terrace. But it is quite important to have the water flow at uniform rate on every line it is to flow on at all, and if not convenient to arrange the ground to have it so, then plant the trees on such lines of regular flowage as may be natural. Otherwise you will be troubled with the water cutting out and running down hill, and if you don't have it so it will flow on to the next when one basin is filled and it may break the lower side of the basin and cause you more trouble.

As in other flooding, the water should not stand too deep or too long in basins. It is better to repeat oftener than to try to force in so much at a time as to make a mud-puddle of it. Use care, too, to keep

the bottom of it as near level as possible so that the water shall be of nearly uniform depth over the whole. And leave a mound of earth about the tree so that the water shall not touch the trunk. Even if you are not irrigating enough to hurt it, there is no excuse for it and it is bad in principle.

Your water supply may be so limited either in quantity or mode of delivery that you cannot even afford to flood in this limited way. Suppose you have a stream of only a single inch or half an inch, but can have it all the time or most of the time. I am in much this situation myself. Living just over the city line, I am dependent on a neighbor's windmill with several others. The pipes are so small that if I run much over quarter of an inch at a time I take the head off the pipes so that my neighbors can get no water. I have some trees that bear very fine fruit, and like to play with them. I have therefore to utilize every drop of the water, and can spare none for mud to bake in the bottom of a basin. I therefore make a ring about six inches deep about a foot and a half from the trunk of a tree. Two or three feet from this, according to the size of the tree, the amount of fruit on it and what I want it to do, I make another ring surrounding the first. The two are then connected with two or three cross cuts. Into this I run a connection from the next tree by a small furrow; I then start with about one-third of an inch of water, just enough to run over the first furrows and rings and get into those of the next tree without puddling the ground in the first ones. When it has passed on to the last tree I then turn it down to a point that I think my neighbors will stand, and let it run several hours or as long as the tank will stand that time. After the water is turned off, if I happen to be too lazy to cultivate—I don't say that I am—I can hoe back the loose dry earth into the furrows and make a fair mulch of it.

In this way I get the largest results from the smallest amount of water, as it runs clear and makes no mud and does not break away. If I had a good windmill and tank of my own I could manage an orchard of five acres in anything but oranges, which need better treatment for good yields, and raise large crops of good marketable fruit. But this is on ground and under a rainfall that will in most all

years raise fair crops of all deciduous fruits without any irrigation and with good cultivation alone will produce fifty bushels of corn to the acre in eight years out of ten without a drop of rain touching the ground after the seed is planted. On pure desert such irrigation would be about useless, unless almost continuous.

CULTIVATION NECESSARY.

For all this limited work good cultivation is about as essential as for any other. The whole ground should be well stirred to retain the moisture from the rains, and basins should be broken up after each irrigation. Some fill them with a mulch of sand, manure, sawdust, tan bark or other stuff, and never break them. Where they are very small, as around flowers or similar things, this will do well enough,

and also around trees if you do not hire help and have not the time to do it yourself. But it will pay to spade them up with a potato fork each time. And the cultivation of the whole field should not be neglected unless for very good reasons. If the surrounding ground is left dry and hard, it will quickly sap the moisture from the outer edge of the portion that has been wet by the basins, and all the evils of this system heretofore explained will show themselves in their worst forms. And try always to use about the same amount of water for the same length of time. Otherwise uneven wetting of the flower-pot you thus form for the roots will result, and those that are in wet enough ground this time may be the next time in ground too dry.

SOME RECENT DECISIONS RELATING TO IRRIGATION.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN all the states of the arid region there should be a statute authorizing the condemnation of lands for rights of way and reservoir sites. And for the purpose of working the greatest good to the greatest number this law should be broad enough to permit the condemnation of water rights. Of course, just compensation must be given in each case. Coupled with this law there should be another. A law should be enacted compelling the various persons or corporations operating irrigation plants to deliver water (should they have it) to all persons applying therefor in their order, provided a tender of just compensation or the legal rate for such water be made. Some states have these laws, but many have not.

In the recent case of the Northern Colorado Irrigation Company, plaintiff in error, vs. Richards, decided in the Supreme Court of Colorado, and reported in 45 Pac. Rep., 423, upon the above subject, it was held: In an action against an irrigation company for refusal to furnish plaintiff water for irrigating land lying under defendant's canal, and having no other source of supply, plaintiff testified that he applied to defendant's manager to learn the water

rates, and told him that he was willing to pay \$1.50 per acre, and that the manager showed and read to him the contract, and said he could not furnish him the water at that rate unless he paid a certain bonus. The court held that the evidence showed a sufficient demand by plaintiff and an unwarranted refusal by defendant.

The general statute of Colorado provides as follows: "Any person or persons, acting jointly or severally, who shall have purchased and used water for irrigation for lands occupied by him, her or them, from any ditch or reservoir, and shall not have ceased to do so for the purpose or with intent to procure water from some other source of supply, shall have a right to continue to purchase water to the same amount for his, her or their lands, on paying or tendering the price thereof fixed by the county commissioners," etc. The plaintiff applied for and procured water for the irrigation of 120 acres of his land during the season of 1888, paying therefor the rate fixed by the county commissioners; broke and improved the land and used the water on it for that season. This gave him a status which enabled him to invoke the foregoing provisions of the statute, in

so far, at least, as to require the company to accord to him a preference to the same amount of water, for subsequent years, over new applicants. And the court upon this subject so held.

And upon the subject of damages where in an action against an irrigation company for the refusal of the company to furnish water in the year 1889, to irrigate his land lying under the company's canal, and having no other source of supply, it appeared that the plaintiff obtained water from defendant in 1888, and in the spring of 1889 demanded water for that season. There was evidence of the rental value of the land for 1889, and that plaintiff had, in preparing to cultivate his land in 1889, purchased horses, farming implements, etc., and made other expenditures in the way of permanent improvements, and of the amounts he paid for each; that prior to the demand he had plowed and planted forty acres; that he raised a partial crop; that, had defendant furnished water, he would have realized from the increase in the yield about \$1,500, without deducting

the cost of raising, harvesting and marketing; and that he lost \$600 in fruit and native trees. The rental value was not limited to the 120 acres, for which defendant was obligated to furnish water. The court held that the measure of damages was the difference between the amount realized from the crops and the amount that would have been realized had the water been furnished, less the cost of raising, harvesting and marketing, together with the loss of the trees and the loss of use of part of the 120 acres plaintiff was prevented from cultivating; that for lands not seeded at the time he was entitled to the rental value; that, if by reason of defendant's refusal, the improvements and preparation became in part useless to plaintiff, or were of less value and use to him, the fact of such improvements, etc., should be considered in estimating the damages, and that he should be allowed the rental value of his land in its improved condition, if he was deprived of the use thereof by defendant's wrongful conduct.



PAMONA'S HOME IN SOUTHERN CALIFORNIA.

Courtesy, Land of Sunshine.

WINDMILL IRRIGATION.

NEARLY every farmer can find a few acres on his farm with a water supply, either from well or creek, and a surface suitable for irrigation. On sandy plains, which are usually level, large tracts of land are fitted for this system of farming, being leveled down or filled up in order to make the entire field, or set of fields, present a proper surface for flooding. Windmills, as now constructed for irrigation purposes, can successfully compete with irrigation canals, and they are more satisfactory, as the first cost is the only one. Each man owns his own plant, and is not subject to constant outlay of money to go into the hands of the owners of large irrigation systems.

In those regions called semi-arid, where only an occasional watering is needed, other than that given by nature, farmers in general do not attempt to irrigate their entire holdings, but only a small acreage of garden, root crops, fruit trees, and occasionally a grass plot. Such places being isolated from any general irrigation system, much economy must be looked for in the use of water which usually must be pumped up from small streams or wells of varying depths. Whether the water be obtained from either of these sources the farmer can choose for himself, taking that system which will be cheapest and most suitable to his location and surroundings.

INCREASE IN VALUE OF LAND.

Thousands of acres of land which in the past have been worth from 50c to \$3 per acre and have been considered practically valueless for cultivation are suddenly increased in value to \$25 or \$30 per acre by the use of a windmill irrigation plant. The soil in the semi-arid regions is the most fertile in the world and it simply requires water to make it produce abundant crops of every nature.

THE RESERVOIR.

Too much importance cannot be given to the necessity of sending over the ground a large volume of water at one time. It must be a flooding of the ground, not a moistening. In some cases the greater the depth of water that is put on the ground at one time the better; hence the

necessity of an ample reservoir. In no case should one be less than 50 feet in diameter with walls that will hold water four or five feet deep, and a larger reservoir is preferable.

Where a small reservoir is used a correspondingly small piece of ground must be flooded each time and the flooding must be done oftener. This has its advantages in this, that there is not so much water lost by evaporation from the reservoir while filling. The best form of reservoir is round. A round reservoir exposes less wall through which the water can seep, and from which it can dry out, and is easier to build.

In a round reservoir 50 feet in diameter and four feet deep there is 13 per cent. less wall surface than in a reservoir of equal capacity built up square, and if the reservoir were built long and narrow the amount of wall surface in proportion to its holding capacity would be vastly increased. However, in the opinion of some, reservoirs should be built oblong, say 50 feet wide and 100 feet long, or 100 feet wide and 200 feet long, etc., and extending at right angles to the prevailing wind, as the momentum of the waves in traveling a considerable distance will be likely to injure the banks. A location should be secured if possible, with hard pan or tough clay sub-soil. If possible place it on the highest part of the plot to be irrigated and as near as possible to the source of the water. If there is any slope whatever let it be away from the reservoir. It should be borne in mind that hillside as well as level ground can be profitably irrigated, if proper care is taken in the location of the reservoir. Occasionally good results are obtained by building a dam across some depression thus necessitating an artificial bank only on two sides of the reservoir. Sometimes also a sloping depression on a hillside is inclosed at the lowest part by a substantial dam. Most reservoirs are made by simply scraping up from the outside of the reservoir a ridge of dirt sufficiently high to give, 4, 5 or 6 feet of water on the inside. No dirt should be thrown up from the

inside of the reservoir because it is desirable to keep the bottom of the reservoir as high as the surrounding land, and and because the surface of the ground holds water much better than the strata further down. However if there is any sod upon the ground where the embankments are to be made, the ground under the locality of the embankment should be thoroughly ploughed, and the sods removed as sod is not a proper material for the construction of embankments, and there would always remain a possibility of water seeping through at the bottom of the embankment.

the embankments are constructed it is well to fill the tank partly full with water and allow it to seep out.

While the bottom is still muddy turn into the reservoir horses and cattle, and drive them around for many hours, thoroughly puddling and pulverizing the ground. Some invert a scraper, and with two teams of horses drive around upon the inside of the inclosure, riding in the scraper. If this work is done thoroughly you will have a reservoir which is practically water tight. In sandy soil it is well to haul in old straw and hay, scatter it around, and tramp it into the mud as



This is a reproduction from a photograph of an irrigating outfit owned by G. M. Davidson, Larned, Kan. It consists of a 12 foot pumping Aermotor on a 30 foot steel tower with an 8 inch irrigation pump. The mill is never turned off and irrigates perfectly 10 acres of ground, which is kept thoroughly soaked. The reservoir is 60 feet in diameter, 5½ feet high and the pump fills it in 10 hours.

Now, with an ordinary scraper commence scraping up soil from the outside of the reservoir to form the embankment. The earth should be thoroughly leveled, pounded and packed, as it is thrown in place. No attempt should be made to mix rock or other material with the dirt composing the walls. The embankment should be very wide at the bottom, sloping up very gradually from the inside, as the waves would destroy perpendicular embankments. Walls from four to six feet in height are usually to be preferred. When

much as possible. If the bottom should still continue to seep, it will be necessary to haul in a few loads of earth or clay. Every western farmer knows of the dry buffalo lakes that are found everywhere upon the great plains. Material taken from these lakes is most excellent for the construction of the bottom of reservoirs. Additional hay or straw can be put in, and it will in time make the bottom of the reservoir practically tight.

There exists no necessity, except in some extreme cases, for the use of cement, pitch

or tar, as the reservoirs, by hauling in a sufficient quantity of mud, clay or even the magnesia deposits that are found all over the west can be made practically impervious to water. The dirt walls upon the inside are much better if sodded; otherwise they are likely to cause trouble by the washing of waves. An excellent plan will be to riprap the embankment on the inside if stone can be had. By rip-rapping we mean to place stone closely together without order on the inside of the embankment. It is often the case that planks are thrown into the reservoir, which will of course be blown to the opposite side from which the wind is blowing, which will prevent in a measure the waves from washing against the bank. An excellent plan is to plant water willows all around the embankment, which will in a short time grow up and serve as a very effectual wind break.

In the construction of reservoirs where the depth of wells is such that more power and expense is required to lift the water, great care should be exercised in their construction. It is well in such cases to make a deep reservoir. These should be constructed more slowly than where the mills are pumping from shallow depths.

Build up the sides of the reservoir about two feet in height, then turn in the horses and cattle, and allow the puddling operation to go on for a couple of weeks; then raise the banks another foot and continue the process as before. In this way reservoirs can be made upon the upland where the depth of water within the reservoir can be maintained at a depth of seven or eight feet. This will insure less evaporation, and therefore greater economy.



Photographic reproduction of a windmill irrigating plant owned by T. J. Dyke, Garden City, Kan. It consists of two 12 foot Aermotors with 10 inch pumps upon 12 inch strokes. The reservoir is 100x150 feet and 4 feet deep. The water is raised 15 feet. The amount of land irrigated is 28 acres.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

THE AMOUNT OF WATER NEEDED FOR EACH IRRIGATION.

BY F. C. BARKER, OF NEW MEXICO.

THE amount of water needed for irrigation in the arid regions is a very difficult problem to solve. So much depends upon varying circumstances, such as the kind of crops, quality of soil and the amount of evaporation. As a rule, I think, writers upon this subject err in fixing the quantity of water too low. Indeed, there seems to be a kind of rivalry as to who shall lower the record. I will, however, give a practical instance of how much water actually may be needed, as it will be of considerable service to gardeners and others who contemplate erecting windmill pumps.

In June last I erected an eight-foot windmill and pump, lifting water about twenty-one feet into a reservoir holding 55,000 gallons of water. Theoretically the pump would lift 800 gallons per hour, with a fifteen mile breeze, which would fill the reservoir in seventy hours, or say three days. But fifteen-mile breezes cannot be relied upon to blow continuously every day, and as a matter of fact it usually takes twelve to sixteen days to fill the reservoir. Presuming that it was filled and emptied twenty-four times in the year, there would be enough water to cover two acres of land with twenty-four inches of water in the course of the year. Now, most writers on irrigation maintain that this amount of water is sufficient for anything, and indeed that, with proper cultivation, even twelve inches are sufficient. But an ounce of practice is worth a pound of theory, and this is what I actually found in practice to be the amount of water needed.

I had put in an acre of strawberries, and the windmill and pump were erected so as to give water in case the river, from which

we usually irrigate, went dry late in the summer, which it is very apt to do. We got our last irrigation from the river on July 2, and on July 15, as my reservoir was full, I decided to irrigate from that, although the strawberries had not yet begun to suffer from drouth, and the soil at the depth of five or six inches was quite moist. The water in the reservoir was about four feet six inches deep, and the outlet (6x4) emptied it in a little over two hours, so that we had a good head of water, indeed as much as the laterals would carry. The actual amount of land irrigated was just four-sevenths of an acre, so that the soil had taken up three and a half inches of water. There had been very little loss by seepage in the laterals, as these had been previously puddled by muddy water of the river, and as I have said before, the land was by no means exceptionally dry. The beds were irrigated by the flooding system, but had I opened up small furrows by means of a hand wheel plow, I daresay I could have easily irrigated three-quarters of an acre, using, say three inches of water.

These results go to show that crops like strawberries, needing an irrigation during the dry season every ten or fifteen days, will require from six to nine inches of water in the month, which is a totally different theory to twenty-four inches in the year. One ought to reckon by the month and not by the year, for there are many months in the year in which little or no water will be required. Compared with many of the results of windmill irrigation, which are given in the papers and printed as testimonials, the above looks very much like a failure. So far as I am concerned, it was a success, for it saved my strawberries, which at a very low estimate are worth \$300, which was just the cost of the windmill, pump and reservoir, so that the in-

vestment has paid for itself the first year.

I ought to mention that I have a driven well, with a four-and-a-half inch Cook's strainer for a point, and as it gets into quicksand or coarse gravel the water flows in very freely. Indeed, I believe it is nearly if not quite equal to an open well, for the pump lifts about the same amount of water that the manufacturers claim it should lift in an open well, which would be too costly here, owing to the quick-sands.

So far as I am able to form an opinion, I am inclined to think that where more than small gardens of one or two acres are to be irrigated, a gasoline engine would, on the whole, prove more satisfactory than a windmill. It is true that the running expenses would be greater, but the initial cost would be less. Moreover, after the first forty-eight hours run, one is able to form a pretty accurate estimate of the amount of land that it will be safe to put under crops, whereas, with a windmill, one has a very uncertain element to contend with, necessitating a much larger reservoir so as to provide against calm weather.

CALIFORNIA'S ORCHARDS.

BY W. C. FITZSIMMONS.

FROM the different county assessors returns the following figures of orchard trees in California are taken and may be regarded as wholly reliable. In two counties, Yolo and Sierra, the number of non-bearing trees does not appear in the assessors' report, but leaving those out the number of bearing fruit trees in the state is found to be 15,170,563, and those not yet of bearing age, 14,487,869; making a grand total of 29,658,432 fruit trees in the orchards of California on the first day of March of the present year. By adding to the list of non-bearing trees the probable number in Sierra and Yolo, the total list of trees would be swelled to a round thirty million at least, and that figure may be taken as the official enumeration of the fruit trees now growing in the orchards of this state. The banner county is Santa Clara, whose principal town is San Jose, sixty miles from San Francisco. This county has 2,631,745 bearing fruit trees and 1,933,804 not yet bearing. Of these 1,651,167 are bearing prune trees and 1,456,967 non-bearing prune trees. This regal county also has 539,612 apricot trees

and 522,776 peach trees. The cherry trees number 159,263, the pear trees 142,779 and the lemon trees 1,354.

Los Angeles county stands second on the list with 734,675 bearing, and 1,911,030 non-bearing fruit trees. The principal factors in this vast aggregate are as follows: orange trees, 754,575; lemon, 287,715; prune, 346,595; olive, 252,940; apricot 227,410; almond, 172,850; walnut, 140,675; peach, 315,400; apple, 77,380.

Riverside county ranks third in the number of its fruit trees, the total being 1,855,902, of which 841,132 are orange, and 133,772 lemon trees. The apple, apricot, peach, cherry, fig, olive, prune, plum, almond and walnut are also well represented in Riverside county, the planting of these varieties having increased greatly during the past three years.

San Bernardino county follows close to Riverside with 1,753,720 fruit trees, of which 1,001,410 are orange and 41,000 lemon trees.

San Diego county has most lemon trees, that being a favorite product of the southernmost county in the state. The total number of fruit trees in that county is 1,235,076 of which 375,372 are lemon trees.

One of the remarkable features of the assessors reports referred to above, is the fact that Butte county has 160,430 orange and 1,930 lemon trees, all growing and most of them bearing fruit within a few miles of the eternal snows of the Sierra Nevada mountains, and five hundred miles north of the smiling citrus orchards of sunny San Diego. In fact the unpoetical figures of the county assessors but serve to strengthen the conviction that the state of California, with its infinite variety of soil, climate and conditions, is soon destined to be recognized as the world's great fruit orchard.

Marketing.—Common sense and good judgment must be brought into full play in marketing your products, of whatever kind. The profits are all found, if there are any, in the last dollars you receive as the price ranges from low to high.

Leave the irrigating ditch in good order when you shut off the water and it will save you needless worry and trouble when you turn the water in next time.

Beet Sugar.—An idea of the growth of the beet sugar industry can be gathered from the following figures, which shows that the beet sugar made in the United States was in

1891.....	10,231,350 lbs.
1892.....	24,675,876 "
1893.....	50,000,000 "
1894.....	70,000,000 "
1895—Estimated large increase over 1894.	

Japan is only importing 25 per cent. of its requirements now, as against 67 per cent. six years ago. This fairly illustrates how the gold standard is not opening the markets of the world to our manufacturers. It is developing the industries of all silver-using countries and destroying the industries of the United States.

Money of ultimate redemption in a county printing office—gold, silver, copper, brass, fenceposts, hay, grain, live stock, potatoes, woodpiles, sawhorses, fish-poles, bedclothing, old hats, carrots, anything and everything in fact. Bring in a wheelbarrow load.—*Mt. Pleasant (Utah) Pyramid.*

For the past few months the University of Illinois has been furnishing Pasteurized milk and cream to families in Champaign and Urbana. The greatest care is taken in its preparation, and the floor of the dairy barn is flooded and scrubbed every day. The undertaking is meeting with great favor.

The manager for an Australian enterprise for exporting live cattle to England admits they have no chance of competing with North American raised beef. The longer passage required injuriously affects the quality and appearance.

Minnesota creameries turned off 27,000,000 pounds of butter in 1895. The proportion of creameries using the separator process has increased from 45 per cent. to 60 per cent. of the whole, and those operated on the co-operative plan from 42 to 60 per cent.

During May, the exports from the United States were \$66,525,169, as against \$64,267,179 in May, 1895. For eleven months ending May 31st, they were \$815,971,764, against \$752,570,335 for the corresponding months last year.

Four thousand boxes of pears and plums, the first shipped this year, reached

London by the steamer *St. Louis* on the 23d of July in perfect condition and sold for handsome prices. California fruit is gaining in popular approval.

A visitation of army worms in the eastern states is a new experience, and in several localities the damage has been very great, and in some of the cranberry bogs almost irreparable.

The French prune crop of the Pacific states is exceptionally fine in size and quality this year, and is estimated at 35,000,000 to 40,000,000 pounds.

It is no loss of time to give the boys and the hired man an occasional outing. It affords rest for them and breeds good feeling for you.

Watch closely and be prompt to eradicate every disease that appears, no matter how radical a remedy may be necessary.

A ton of well cured corn fodder has nearly as great a feeding value as a ton of average hay. It should not be wasted.

Time spent at the county fair is about as good an investment as the farmers can make of it for himself and his family.

When cattle reject corn fodder it is because there has been something wrong about the cutting and curing of it.

Many varieties of fruits and vegetables are excellent for home use that are not profitable to send to the market.

Many western packing houses are closed, there being a very limited demand for products, despite the low prices.

Sixteen white chickens and one black one hatched in one brood have been exhibited at Springfield, Mo.

The good wife is just as much entitled to have extra help when there is extra work as is the good husband.

There are about 200 different shapes of tooth pulling forceps—veritable pain-producers.

Some farmers produce at less cost than others. Why? It is worth thinking about.

Ninety-five thousand tons of American apples find a market in England every year.

Vast quantities of American canned salmon are to be shipped to England this year.

PULSE OF THE IRRIGATION INDUSTRY

WHY THE AGE IS LATE.

THE enforced absence of the publisher, from Chicago, occasioned by sickness, is the cause of THE AGE being a little later this month than usual. The next number, however, will be out on time.

The editorial discussion on "The Progress of Western America" will appear in the next issue as usual.

WYOMING'S BOLD APPEAL.

WE favor laws in aid of irrigation. We need settlers to open our mines, to make homes on the millions of acres of irrigable and fertile public land, to develop and utilize all our immense but unused resources.

If the great rivers which now run to waste were diverted and used, if the valleys which border them were reclaimed and occupied, it would add hundreds of thousands to our population and hundreds of millions to our taxable wealth. It would stop the drain of money sent each year to surrounding states to purchase farm products, revive trade in our cities and towns, lighten the burden of taxes and afford employment to our idle labor. To secure these results and aid those who reclaim and make productive these unoccupied wastes, we favor legislation by the general government in aid of irrigation. We believe that every dollar paid for desert land should be returned to the state and expended on ditches and reservoirs to make those and other lands productive.

We recognize the need of laws to protect and preserve our mountain forests, and favor legislation to that end. The present forest reserve law prevents the legitimate and harmless use of timber by settlers, prevents the ownership or development of mines in reserved areas, and does nothing to protect the forest from fire—the chief agent of its destruction.

We favor laws for the preservation of the native grasses on the open range, and laws which will give to the citizens and taxpayers of this state the exclusive right to occupy and use the ranges within its

borders and protect their homes against the invasion of flocks and herds from other states when owned by non-residents and those who pay taxes elsewhere.

Adopted in Republican convention, Cheyenne, Wyo., August 13, 1896.

DELEGATES TO THE CONGRESS.

The following gentlemen have been appointed by the governors of their respective states as delegates to the Fifth National Irrigation Congress.

Oklahoma—J. V. Admire, Kingfisher; Henry E. Glazier, Stillwater; G. W. Batchelder, Newkirk.

Oregon—Chas. Hilton, The Dalles; J. M. Church, La Grande; John D. Young, Baker City; W. F. Matlock, Pendleton; A. W. Gowan, Burns.

California—Hon. C. C. Wright, Modesto; H. R. McDonald, formerly State Treasurer; E. G. Knapp, San Francisco.

Montana—Z. T. Burton, Burton; Paris Gibson, Great Falls; J. B. Collins, Miles City; Matt Anderson, Bozeman; Donald Bradford, Helena.

IRRIGATION IN CENTRAL AMERICA.

BY JOHN R. CHANDLER.

CENTRAL America has taken a decided step in the last year or so towards the development of resources of every kind, and in so doing has opened up a number of markets for American goods, machinery, and especially enterprises in railroading, canal building and irrigation.

The coffee crop this year will surely be double of last year's and worth fully \$25,000,000, but Guatemala alone has a vast series of plateaus in its central basin which, once given over to irrigation on American principles, would more than double the yearly value of its present exports, in tobacco, sisal hemp or henequer and several other fibres, sugar, cocoa, etc. The plains of Zocapa are easily accessible from the Rio Grande or Motagua river, and irrigation need be no more costly than in our western states.

This territory is now being opened up by the Northern or Interoceanic Railroad,

which is being built through the central portion of Guatemala, mostly by American engineers and workmen.

The Central American Exposition, to be held next year in Guatemala City, under the direction of Dr. Guzman (who was at Chicago), is expected to attract many foreigners, and above all, Americans, as the exhibits will not only be rich but unique. Many of our manufacturers have already signified their intention to send exhibits and European countries are all alive to the advantages this fair may give them in showing of their goods.

NEVADA

Owing to the unusually dry weather which prevailed in eastern Nevada during the winter there will be no grain crop to speak of in that part of the state as the farmers, fearing a shortage in the water supply did not sow. However the alfalfa and wild hay crop is large, the latter being better in the Humboldt River Valley than for several years past, due to the unusually heavy spring storms which caused the river to overflow its banks in June and July.

The short water supply in the earlier part of the season and until the middle of June this year, at Lovelock, on the lower Humboldt River, one of the richest farming districts of the state, has aroused the farmers to the necessity of storing water as a safeguard against the recurrence of this condition, and a search will be made for a suitable site for a storage reservoir. The loss of the grain crop in this district alone this year would have more than paid the cost of providing such storage.

Within the past two years three new flouring mills have been erected in the state, and before long, instead of shipping out wheat and importing flour from California, Nevada will be manufacturing all of this article she consumes.

Present indications are that before the next number of *THE AGE* is out work will have been commenced on what is to be one of the largest storage reservoirs in the country, on one of the main tributaries of the Humboldt River. This reservoir will have a surface area of 3670 acres and a capacity of 80,000 actual feet. It will be formed by a rock-fill dam faced with earth, having a height above the stream bed of 85 feet, a length at base of 115 feet and on top of 240 feet. The water shed which will supply this reservoir has an area of over 750 square miles ranging in altitude

from 5,000 feet to 11,000 feet above sea level, and yielding ample water to fill it. There are over 200,000 acres of fine land under this reservoir in the Humboldt River Valley, a portion of which will be irrigated from it and placed upon the market at a very low price.

KANSAS IRRIGATION CONVENTION.

By authority of the State Executive Committee, the fourth annual meeting of the Kansas Irrigation Congress is hereby called to meet at Great Bend, Kansas, on the 15th, 16th and 17th of October, 1896.

Eight years of drouth and crop failures have riveted the attention of farmers and all classes of people to the fact that irrigation is the only salvation of the Great Plains country. Texas, Colorado, Oklahoma, Nebraska and the Dakotas are pressing forward with unabated zeal towards the reclamation of their lands by irrigation.

Kansas is not one whit behind any of them. She points with pride to the work already done. Within her borders over 2,500 private irrigation plants have been put in since this agitation was begun, besides thousands of farmers have been induced to try irrigation in a small way, which insures them a living outside of their farming.

The Kansas State Board of Irrigation will be here to give an account of their stewardship.

No person should be absent from this meeting who can possibly come. Every town, city and township in the state should be represented. Every person coming will be considered a delegate. The ladies are especially invited. All can have their "say" and ask as many questions on the various subjects as they desire.

The railroads have made one-fare rates in the state of Kansas, Kansas City and St. Joe, Mo., included, excursion tickets to be sold Oct. 14 to 16 inclusive, good to return until Oct. 19, 1896. Tickets to be good for going passage commencing date of sale and for continuous passage in each direction.

Great Bend has ample hotel accommodations and take care of all who come.

L. Baldwin, Local Secretary; John^r H. Churchill, President; H. N. Lester, Secretary State Irrigation Congress; John E. Frost, Chairman State Executive Committee; E. R. Moses, Chairman Local Executive Committee.

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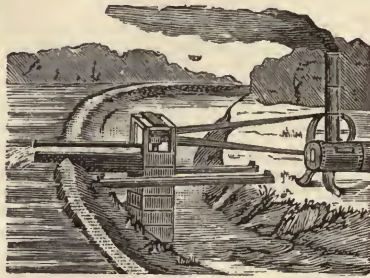
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THE IRRIGATION AGE.

VOL. X.

CHICAGO, OCTOBER, 1896.

NO. 4.

THE PROGRESS OF WESTERN AMERICA.

Stagnation of Immigration.

More and more, as the stagnant condition of irrigation enterprises in general is recognized, does it become evident that upon colonization depends their salvation. Very few of the men who organized irrigation companies and concocted plans for reclaiming the desert, gave to this most important feature the consideration it merited, or, in fact, gave it the consideration it must have in order to insure the success of their enterprises. The building of dams and ditches and the furnishing of water does not constitute a completed irrigation enterprise. By far the hardest work yet remains to be done. Colonies will not organize and locate themselves, and the systematic study and active operation of the best means to promote immigration is the only door through which will come back the vast sums of money that have already been expended. It is not the writer's purpose to review the failures that have been made, nor to enter into details of those other absolutely essential factors of an irrigation system—water supply and able engineering. But it seems particularly appropriate, at the close of the present season, when so many of the companies have closed their eastern offices, to briefly discuss a few of the more prominent factors that have led to these results. Behind all of these effects stand fundamental causes, and the inflexible laws that govern human affairs must be studied carefully and thoroughly and with a mind fitted to grasp and understand their true meaning, before success can be hoped for. The movement of population from town to country and from country to town is governed by laws as fixed and rigid as those that govern the science of money. Coun-

try people do not seek the cities from mere impulse, and sentiment is not the greatest factor in inducing city people to lead the life of a farmer with its drawbacks and its advantages. Beneath this there is a motive. It is the hope of improved condition, either in mind, body or estate—in health or in prosperity.

Colonial Idea Developing.

Upon a correct interpretation of this hope rests the future—not alone the future of irrigation, but the future of the country, because irrigation is the safety valve of America. It is needless to show that we are rapidly approaching a European standard of concentration of people within a circumscribed area, in order to show the nearness to the danger line, because we have already begun to feel some of the effects of this concentration, and a man who has been stung by a bee does not need to be told that a nest of them is more dangerous than one. The question is, "How can the congested population of the cities be taught to seek the country?" The answer must lie in a visible demonstration of the hope for better conditions. Irrigation furnishes the basis for this realization. It presents a method of preventing that which the antagonists of anarchy dread, and it presents an opportunity of accomplishing that which philosophers, philanthropists and statesmen so much desire—the bettering of humanity. And this question must be solved, not alone by those who would directly profit thereby, but by the people themselves. The colonial idea, which has been placed before the public by one of the foremost of America's writers on the subject of irrigation, is getting nearer to the heart of the people, and

it would not be surprising if the next twelve months saw some wonderful developments in this line.

Associative Colonies. The associative principle, as distinct from the co-operative, is making strong friends, and it both leads to and follows as a consequent the forming of colonies. It is an essential ingredient of success. It can be traced to its earliest beginning in the dawn of civilization, when men gathered together for mutual protection and conquest. And it now offers a sensible and practicable method for "The Conquest of Arid America." The association of people with a common purpose in view is the lever that will move population westward to settle on the irrigated farms and in the villages and towns, to create industry and prosper, to foster culture and social aspirations and to establish a civilization that will be a type of all that is highest and noblest. But this will be the work of time. To accomplish it many forces will have to combine. What is needed now is the study of this question and the systematic promotion of immigration by the legitimate irrigation enterprises. Immigration can be secured only by offering superior advantages. Climate, soil, products, markets may all be right, and still there be a lack of activity. It is here that the associative principle comes into play. The average man will not, for himself or his family, willingly choose to live a life of isolation. He must have neighbors; he yearns for human companionship.

The Dawn of a New Day. It is in the "Model Colonies" that have been set forth heretofore in the pages of this magazine that he sees the nearest approach to a realization of these hopes. And the almost unnoticed currents that have been tending in this direction are concentrating into a broad and deep channel and flowing onward with the force of a mighty river. Already is it gathering itself for a plunge. This tide is destined westward where the most inviting conditions are offered, where irrigation presents the greatest opportunity a nation ever had for conquest and the founding of an empire. It is time for the men of the West to arise and with one voice welcome the dawn of this new day which has appeared on the eastern horizon. It will lead them out of the

wilderness of financial difficulties and embarrassments in which they find themselves through a lack of knowledge of natural laws. Then let every effort be made to hasten the day of realization.

A Southern Drought. The drought, it seems, is not confining itself to its usual habitat in the far western states. For the second time in the past two years it has invaded southern territory. This time northern Louisiana is suffering, and already calls for outside aid are being made for the benefit of those whose crops were failures. The South, in a general way, began to take an interest in irrigation a few years ago. Last year a convention was held at Atlanta, which was reviewed in these columns at that time, and the engineering societies and clubs of the southern states began to discuss the subject, but by far the greater proportion of the farming element has taken little interest in this matter up to this time. Irrigation is not a new idea to the South, as it has been in practice there on the rice fields for many years (as shown by Mr. Hutson's contribution in this issue), but the idea that it could be applied to general farming, market gardening and fruit raising is new. Those who had the courage to undertake something which, at first sight, seemed to be out of the beaten path, have profited thereby, and their visible success is convincing the doubters. Irrigation is now, to a limited extent, applied in the raising of small fruits and vegetables in all the southern states bordering upon the Atlantic and the Gulf. Its greatest application, however, is in the rice fields, and as an instance it may be mentioned that in the Lake Charles district, in southwest Louisiana, over 3,500 self-binders are in use at this time harvesting the rice crop.

Fairs and Conventions. Within a short time another season of fairs and conventions will have been added to the list. From north to south, from east to west the citizens generally, and the farmers particularly, have given themselves to the enjoyments of the county fair and its larger expression—the festival of Ceres. In the northwest the Minnesota state fair and festival at Minneapolis, not to mention the annual encampments of the G. A. R. and the Knights of Pythias, attracted wide attention. The fair, while a local institu-

tion, was not confined to the state boundaries. The states of Montana, Idaho, Washington and Oregon were represented by exhibits from their farms, orchards, forests and mines. To the general exhibits were added some special features, and of these the most noteworthy was the exhibit car of the Northern Pacific Railway. It was a splendid demonstration of the resources of the northwest, and was constantly filled with crowds of people. In the southwest the fair at St. Louis easily occupied the place of prominence, while it must not be forgotten that Omaha and Kansas City were close behind. As for the festival of Mountain and Plain at Denver, it was unique in the extreme, and excited the wonder of eastern visitors. The details of each of these festivals, and the innumerable others that have been or are being held, is already well known, and it is not our purpose to enter into them further, except to show their influence upon irrigation.

Their Relation to Irrigation.

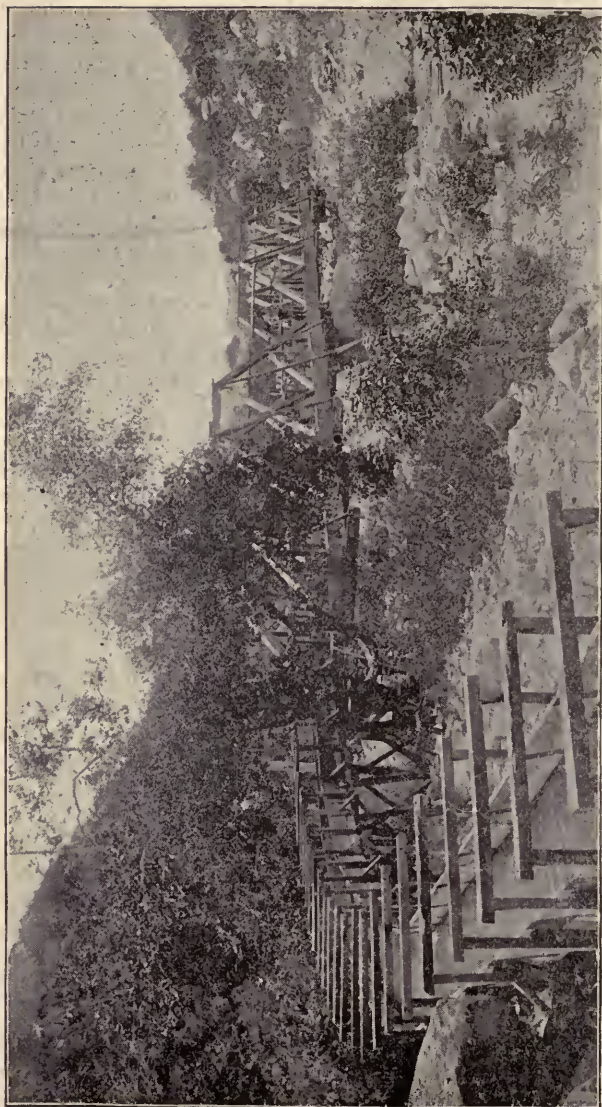
It is cause for congratulation among those who are working in behalf of irrigation, that it has begun to occupy, in a measure, the position that it merits as the most scientific and sensible method of practical agriculture. With scarcely an exception it was represented at each of the exhibitions held west of Chicago, and at many of them it occupied its rightful place of prominence. It cannot be denied that while irrigation is of more direct importance, and capable of being more successfully applied, in our western states, where the lack of rainfall makes it necessary, and because this lack of rainfall makes it possible to apply water when vegetation needs it and prevents floods, which destroy crops as quickly and easily as drought, there are numbers of inhabitants of the prairies and valleys who have hitherto failed to see that they could not carry on their farming operations as did their fathers and grandfathers. And notwithstanding the loss of crop after crop, and with failure staring them in the face, they have concluded to trust once more to the element of chance—that it might rain when their crop needed it. It is among these “farmers of the old school” that the agitator of irrigation has been and must continue to work. But it is a pleasure to chronicle the fact that these farmers are now turning to irrigation with

enthusiasm, that they appreciate its advantages and realize that they are no longer dependent upon chance for success.

The North Platte Fair.

At the time of writing this there is being held in North Platte, Neb., an irrigation convention that is remarkable in several ways, but more particularly in demonstrating the progress that Nebraska, and not only Nebraska but the entire semi-arid region, has made in solving the question of agriculture on the great plains. No longer does Nebraska ask aid for its drought sufferers; no longer is the population decreasing because of unsuccessful farmers leaving the state for more favored regions; they are irrigating with the aid of canals and ditches and with windmills and pumps, and they have again begun to feel that spirit of conquest that filled them when they undertook to make homes for themselves and families on the lonesome prairies. But the practical side of irrigation predominates at North Platte. It is the side that most quickly appeals to the average farmer; “How can we irrigate?” And the officers of the irrigation fair have attempted to answer this query. They have arranged an exhibit of windmills and pumps; they have built a miniature canal with laterals; they have every variety of appliance needed in irrigation, and above all else they have made an exhibit of the products of irrigated farms and orchards, a practical demonstration of what has been done.

Good Roads. Never before in a political campaign has there been manifested such an interest in “good roads” as is shown at the present time. The bicycle associations all over the country have taken up the battle for good roads, and are requiring pledges from their local candidates favoring the use of convict labor upon the roads, instead of using the inmates of penitentiaries as heretofore in producing manufactured articles in competition with free labor. No one, except the companies and individuals who benefit thereby, will contend that the contract system in vogue in many of the states is a wise method of employing those who have been convicted of felony, and it has long been seen that a change must be made. The building of good highways would benefit not only the



AN IRRIGATION FLUME LINE IN SOUTHERN CALIFORNIA.

particular localities through which they pass, but it would benefit the state at large, and no one would derive more benefit from this improvement than the farmer. As an instance, it is estimated that in the state of California alone the cost of transporting products over roads, good, bad and indifferent, was \$66,000,000 last year, whereas, if the roads had all been in good condition, it would have cost only \$36,000,000. This saving would have been placed to the credit of the farmers. While it is true that there has, in the past, been a feeling of antagonism between the farmers and the wheelmen, it is now time that both sides should be willing to make concessions, in order that both may benefit. The movement in favor of good roads deserves general and hearty support.

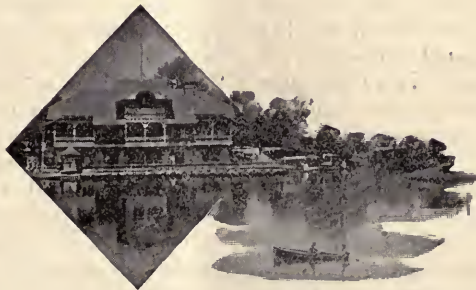
Secretary Coburn, of Kansas. The object lesson that Secretary Coburn of the Kansas State Board of Agriculture offers as a means of making his official position and labor therein of practical value to the farmers, is indeed a striking one. This indefatigable secretary, with an amount of labor that is simply wonderful, prepares bulletins and reports and scatters them far and wide, and not the least feature of this is that every bulletin and every report is of the most intense and practical interest to those for whom they are intended—the average farmer. The work done by the state boards and schools of agriculture and the governmental experiment stations cannot be overestimated. No other single industry is so well cared for as agriculture, and no other industry so much needs it or so well repays the time and money spent by the state and federal governments.

Steady Progress. In no department of journalism has there been a greater advance, both as to the number of its representatives and the character of its contents, than in the agricultural and horticultural press. Within the past thirty years even those which were thought in the earlier days to be the best possible, have introduced improvements of great importance, and have kept well abreast the times in every respect. They have been, and are a vast power for good. They disseminate information which affects the material and social welfare of the largest single class of our population, and are now commanding and liberally compensating a high order of talent.

Significant Protest. The Northwestern Wholesale Grocers' Association addressed a formal communication to the leading dried fruit association of California, of which the following paragraph was a part.

"This Association, representing as it does all the wholesale grocers doing business in the Northwest, protests against the present demoralized condition of the dried-fruit market, growing out of the indiscriminate shipments of dried fruits by the fruit-growers of your State to farm produce and green-fruit dealers in this section of the country.

Important Decision. The United States Supreme Court some time ago decided that the desert land law did not apply to lands within the limits of a railroad grant. It naturally follows, although this particular point has not been officially determined, that all entries under the desert land act were erroneously allowed, and that where the final proof and payment was not made, the entrymen were entitled to the amount they had paid, under the act of June 16, 1880.



IRRIGATION OF RICE IN SOUTH CAROLINA.

WHERE IRRIGATION HAS BEEN PRACTICED FOR A CENTURY.

BY WILLIAM FERGUSON HUTSON.

WITH the probable exception of some of the lands originally cultivated by the Franciscan missionaries in Texas and New Mexico, the rice industry of South Carolina and Georgia is the oldest example that we have in this country of a system of agriculture based on irrigation, and absolutely dependent on it for its existence. The records as to when the different plantations were cleared and banked are, with scarcely an exception, lost; some in the Revolutionary and the rest in the late war, but the places are nearly all about as they were a hundred or more years ago, for so well were the fields laid out that the modern planter finds little in their arrangement that he need ever change. Many things, including the climate, character of the labor, and system of cultivation under which each planter controls his own water supply, force the use of large plantations and forbid any attempt to plant it by small farmers.

The planting of rice is confined to the "low country" near the coast, almost the entire South Carolina crop being raised in the coast counties of Beaufort, Berkely, Colleton and Georgetown, where the country is very flat pine land, intersected by many creeks and rivers, which originally spread wide on either side, making great swamps and marshes. These were cleared, diked and drained, and the differences of locality gave rise to the two different methods of irrigation now found in this region. On the reclaimed swamps and marshes along the large rivers use has been made of the tides, which, coming far up the rivers, back up the fresh water and thus raise it above the level of the fields, while in the once swamp lands higher up the water is obtained by putting a dam across some narrow part, thus making a "back water" from which the rice fields below can be flooded. Sometimes these two methods may both be seen in use on the same plantation, a "back water" be-

ing used to flow some fields that the tides cannot reach.

The river places especially are wonderful examples of hydraulic engineering, and everything about them shows that the early colonial settlers of this part of the country must have commanded a large amount of capital to carry out as a private enterprise such a task as the clearing and diking of a large place.

PREPARING THE GROUND.

An idea of the labor that must have been expended in beginning a plantation can be obtained by noticing the general plan of one and the amount of earthworks necessary to control the water. In the first place, all along the river, and wherever the low alluvial fields do not abut on higher ground, it is surrounded by a strong dike about five and a half feet in height, four feet wide at the top, and with the base in proportion. The fields are divided off into squares or plots of various shapes, in accordance with the slope of the land, the difference in level in one square being usually limited to eighteen inches. These squares are separated from each other by "check banks," about two feet high and two to three feet wide at the top. The squares may vary in size in a large field of several hundred acres all the way from ten to seventy-five acres or even more. Through the fields run canals, so placed that each square takes its water directly from the canal by a double floodgate, called a "trunk," into a canal on the other side, though on many river places the water can be let on the land through "trunks" connecting it directly with the river, and the canals are wholly or partially dispensed with. The "trunks" are simply wooden cribs passing through the embankment, covered over with earth, and having a gate at each end that can be raised for the passage of the water. Where the place is flowed by the tide water all of these flood-

gates are automatic; that is, they hang on horizontal pivots, as well as slide up and down, and when the outside gate is lifted to let the water in from the canal, the inside one floats on top of the water as long as the tide is coming in, and flaps back as soon as it begins to ebb, thus holding the water on the field. The same action, with the function of the gates reversed, takes place when it is desired to drain the water off, the outside gate closing when the tide rises.

The canals, which will average four to a field covering a square mile or six hundred and forty acres, are twenty feet in width and five feet in depth, and take their origin, usually, each independently, from the river by similar, though more perfect, automatic floodgates. For the purpose of making the flooding more gradual and even, and to enable the water to be drawn off very completely, each square has a marginal ditch six feet wide and four deep, cut all around the interior edge a few feet away from the embankment, and in addition, "quarter drains," usually two feet wide by three deep, are run in parallel lines across the square at a distance of about seventy-five feet from each other.

CULTIVATION.

The cultivation of the crop involves the use of water at every stage, and is in brief as follows: About the first of January the last year's stubble is burnt off. The land usually has been lying just as it was left after the harvest, but sometimes, where water is plenty, it has been flooded immediately after the crop was taken off, and has remained so until sometime in December. After the burning, the land is ploughed and put into the finest possible mechanical condition. Planting begins about the 1st of March and lasts until the 1st of May, when it has to be stopped on account of the flocks of "May birds" that stop by on their way north, to be known there as the poetical bobolink. In June, planting is begun again, and continued until about the 20th, making a late crop, always spoken of as "June rice." The

rice is sown thickly in drills fifteen inches apart. The water is then turned on for the "sprout flow" and the land flooded as deeply as possible. Then the whole stretch of fields is one vast sheet of water, the only land visible being the narrow intersecting dams. This sprout flow remains on for from six to eight days, after which it is taken off and the field left bare until the rice sprouts sufficiently for a row to be traced as a tiny green line for about a hundred yards. The water is then let on as deeply as possible for the "stretch flow." It remains so for six to eight days again, and is then lowered until the tops of the rice in the lowest parts of the field can just be seen at the top of the water. It is held so for twenty to twenty-five days, just enough water being added from day to day to keep pace with the growth of the rice. This gives the rice, which projects a little above the water, a very rapid growth, while the weeds and grass, being covered, are mostly killed. The fields are then drained and dried off and the rice hoed by hand, following with a horse-hoe. It usually needs a second hand-hoeing somewhat later in this period of dry growth, which lasts forty to fifty days. Then, about the 20th of June, with the earliest rice, the "harvest flow" is put on, and kept on pretty steadily until the rice is ready to cut, which will be, with rice planted on the 1st of March, about the 25th of August. The water in this flow reaches about two-thirds up the stalk of the rice, and is drained off every eight or ten days and fresh water put on. The water now serves a double purpose, for besides promoting the growth of the plant and the consequent heavy fruiting, it supports the stalk, which, heavy with its head of grain, might otherwise be beaten by a single heavy wind down into a ruinous mess in the mud of the fields.

Here ends the function of water in the making of the crop, the main anxiety of the planter being lest such a storm may come up in the two or three days after the water is taken off and before the ground is dry enough for the harvesters to work.



THE ART OF IRRIGATION.

CHAPTER XVI. THE PROPER TIME TO APPLY WATER. CULTIVATION.

BY T. S. VAN DYKE.

“WHEN it needs it” is the answer the beginner is very apt to get when he asks the experienced irrigator what is the proper time to water something.

The question cannot be easily answered even as to any one thing, and anything like an attempt at a set of rules for a general list of products to apply to all places would be very absurd. It is true that you can soon learn to tell by the appearance of anything whether it needs water. Vegetation of every kind has a mute language that one can learn to read as well as print. Long before there is any sign of suffering or wilting in the leaves, an air of weariness steals over the whole, the brightness weakens just a trifle, and if it is a tree well laden with fruit it will not leave you many days, or in hot weather many hours, in doubt about its meaning.

But it is equally true that there is danger in waiting to be thus informed. If you have your own water system and have it well under control, so that you know just what it will do, you may wait if you choose, though, in such case, there is no excuse for taking chances if your crop is very valuable or easily shrunk by a little neglect at the proper time.

Considerable repetition is unavoidable in a work of this kind, and I will here repeat what is one of the fundamental principles of the whole art of irrigation. Repeat it until it is engraved on the bottom of your memory.

There is very little difficulty about getting fine fruit from young trees, but when they are old and in full bearing and heavily laden, to bring to maturity a large percentage of first grade fruit requires unremitting diligence. Almost all the profit is in the first grade, and this grade is quickly reduced by the slightest neglect, neglect that will not otherwise affect the tree, would not show on a young tree, and to the common eye may not show on the

old one except in the market returns from your crop. Hundreds of dollars a day may be lost without your seeing it until too late.

This principle applies with more or less force to almost everything in the line of orchard or garden produce that you will raise to sell, and you will never lose by applying it to all field crops as well. It is largely ignorance of this that makes so many different opinions about irrigation and water supplies, and makes so many think they are doing wonders when they are really losing money.

If you are depending on a ditch with others you will probably have to take your turn, and cannot have the water just when you want it. If, then, you are depending on the appearance of anything, the time you may lose in getting the water running may be a loss of many dollars an hour; and yet you may never know it. Far better to do such things on principle.

By the time you have watched things long enough to know far enough in advance of actual suffering that they need water, you will also have learned to calculate in advance the time when things will need it. You will have some idea of how much they need, when they last had it, how long a certain run of water lasts with proper cultivation on stuff of a certain age. You will also note the weather, the heat and the amount of moisture in the air. If wise, you will assist your observations by frequent inspection of the soil six or eight inches below the surface. The soil should never be so dry that it will not easily pack into a ball in the hand. A valuable crop under irrigation should be studied every day, just as a successful merchant spends much of his spare time in looking over the books, no matter how much he trusts the employes. You will thus understand the business so thoroughly that you will always have the water ordered in time and ready to run. And with a growing crop

there is rarely danger of being a few days too soon with the water. It is always the other way.

But if you must trust your eye to tell when to water anything, learn to tell in advance of any suffering. Allow nothing to wilt or twist or look yellow, if you can avoid it, for although it may be pulled out all right, something is lost, and there is generally no excuse for it.

LITTLE FEAR OF OVER-IRRIGATION.

The proper time to irrigate will vary with every product, every locality and every temperature. As a rule, one should be careful about applying water too freely when anything is in bloom. The same when fruit is ripening. But to this latter there are large exceptions, especially with berries to be sold fresh in the local market and fruit that is to be sold to the cannery or shipped but a short distance. Injuring the flavor of fruit with too much water is much exaggerated. Much of the California fruit in the eastern market is flat because picked too green, as it must be to stand the long journey. Most of the talk about its being over-irrigated is done by cranks with dry land to sell. Stuff to be shipped far and keep well should not be bloated with water. That is about all there is in it. There is very little danger in watering too often if the ground is well drained and it is not soaked too much. I have seen peaches, plums and pears made very flat and sour, as well as small, on very well drained ground. But it was because the water was running in large quantity almost all the time. I have seen several million times the quantity made small, flat and sour with too little water. Last summer, in my garden, I tried to see how much water a few peach and pear trees would stand. I failed to damage the quality and had the finest I ever saw. But they were not kept in a mud puddle. I watered them every week, but just enough to keep the soil so that it would pack into a ball readily in the hand without any mud clinging to it. It was done by frequent watering with a moderate quantity and digging three days afterward with a potato fork. It is doubtful if any fruit can be hurt as long as the soil is not muddy enough to stick to the hand. And I would rather trust to keeping the soil in that condition the whole season through than to wait for anything to show the want of water. It cannot always be done, especi-

ally on a large scale, but the more nearly you approach it the better.

In southern California peaches, apricots, prunes, and most other deciduous fruits, rarely have an "off year," and when they do it is seldom a serious shortage. This is largely due to irrigation of the trees once, and often twice, after the crop is picked. This starts the trees into a new growth before the setting of the fruit buds for the next year. The most regular, as well as the heaviest crops, are from trees thus treated, and it would be well to follow this course wherever the climate will permit a late growth in time to harden up the wood to endure the winter. This latter is a point always to be kept in mind, for there are many places where a late growth will be nipped by frosts, while in other places it will not. But this recuperation of the tree in the same season will doubtless give it a longer and healthier life, even if it does not save it from an occasional off year.

After what is above said you will see how impossible it is to say how often during the season one should water. It will vary with the soil, the climate, the age of the trees, the nature, and especially the size of the crop, the amount of hot weather, etc. In 1894 I had to irrigate a number of trees twelve times, because the rainfall of the preceding winter had been so very light and the subsoil was dry. The trees were heavily loaded, and I could get but a short run of water and a small stream. Every tree carried its fruit through in fine shape, but if I could have controlled my water supply I could have done it with four irrigations, and had the preceding winter been up to the average in rainfall two good wettings would have sufficed.

SOME GENERAL INSTRUCTIONS.

In general, it is not necessary to water as often as one would suppose, provided the ground is well soaked at each time and good cultivation is kept up. With a winter rainfall of twenty inches, the average of a highly productive and extensive area in southern California, the last rain of any value being rarely later than the 1st of May, followed by seven months of sunshine, with an air most of the time drier than is ever felt east of the Mississippi, and often intensely dry for weeks at a time, the periods of irrigation on well cultivated land run nearly as follows:

Oranges and lemons, four times a year.

(These need more water than any other trees).

Apricots, peaches and prunes, once or twice before picking and once or twice afterward. The once or twice depends much upon the nature of the soil and the ideas of the irrigator. It is the same with pears and all other deciduous fruits.

English walnuts, twice a year.

Corn—most of the corn in California is grown without irrigation, but water three times will double the crop and twice will increase it immensely. If planted straight both ways, as in the east, and well cultivated, two irrigations will more than double the yield. It is the same with beans, beets, potatoes, cabbage, peanuts, peas, and a host of things.

Alfalfa, once after each cutting. Some irrigate just before cutting. This will vary some with locality, but does not affect the rule of once at each cutting. In some places there are seven cuttings a year. Four of these will mature in five weeks from the last cutting; one more will take a trifle longer, the rest considerably longer. At two of these cuttings flooding is sometimes omitted, but seven times a year will not be too much for alfalfa raised for profit in the lands of warm winters.

It will thus be seen that irrigation is not a constant drenching of the soil, or even an attempt to pour on water as often as rain generally falls. It should be at each time what rain ought to be—enough to last until the roots have absorbed it. The quantity should be so great that surface evaporation and drainage beneath can do their worst and still leave enough to carry the plant for a period that, in the lands dependent on rain, is generally considered a drouth.

This assumes a thorough wetting of the whole ground. Where less than the whole is wet with basins or single furrows, there is no possible way of getting reliable data. But even then, two or three times a year more should suffice if the work is well done and the intermediate ground well cultivated.

LOW AVERAGE RAINFALL.

Where the rainfall is but ten inches the number of irrigations is generally increased by two more for oranges and lemons and one more for deciduous fruits. The latter are sometimes watered twice more. Lowering the rainfall to five inches would not

now make much difference, though if the air is very dry it will probably pay to add another dose of water. Reducing it to nothing would make little difference, as a five-inch rainfall for the year is practically nothing. But still, another watering would not hurt it. There is a difference between what you can do and what there is no need of doing that should be kept always in mind, if you want to make money out of the ground. Many give less than the quantities above given, but where you don't have to stint your vegetation don't do it, for, everything else being equal, the most money is steadily made by those who use the most water.

For berries, especially strawberries, and vegetables that are worthless unless crisp and succulent, no analogies like the above are of much use. They need water very often for the best results, but the soil and the weather affect the question too much to allow any rules. In hot weather, if the water, too, is warm, it would be hard work to injure strawberries with a light dose every three days, while there seems no limit to the amount radishes and cucumbers will take without injury.

The practice of irrigators, however, is not always a sure guide. It will undoubtedly pay to irrigate the olive well. I have seen it treated like the orange with stupendous results, but hardly anyone does so because it is so tough and does so much without water that it is generally left to shift for itself. The number of times a year that anything needs water will also depend somewhat on the position of the roots. If you keep a sprinkler running all the time on a lawn you train the roots so near the top that they need water almost constantly in hot weather. But if wet by the running of small streams a long time, or by good flooding, so that the water soaks in deep, the lawn will not need one-fourth of what it needs from the sprinkler, and the roots will follow the receding moisture until the grass will soon go two or three weeks in the driest weather with no sign of suffering. Where water is short it is well to train everything in this way; but where water is plenty almost everything does better with the roots in the top soil where it is richer and warmer and more accessible to air.

I considered cultivation quite fully in Chapter V. Allow no one to inform you it is not necessary. It is entirely too late in

the century for any one to tell us this. At Santa Fé last summer I was shown a fine young orchard of various trees about ten feet apart, flooded but uncultivated, and the trees in such shape that it could not well be cultivated.

"Very good for a young orchard," I replied, when pressed for an opinion.

"And what will be the matter with it for an old orchard?" asked the owner, with a touch of indignation.

"You will wish the trees were so that you can cultivate them," I replied.

"Ha! ha! ha!" he sneered; "we have to plant them close so as to shade the ground in this hot sun."

"We got over that in California fifteen years ago," I answered.

If the ground is well stirred and kept stirred there is not sun enough or heat enough in North America to rob the moisture from the soil in seven months. California proves this in thousands of places every year.

If ground is flooded and then left to bake, as this was, there is not shade enough in Erebus to keep the soil from drying out in half the time it should dry out.

But will you not get more fruit from many trees close than from fewer ones farther apart?

When young—yes; when old—no, not by several fold. And the percentage of first grade will be very light.

I was shown the old Chisum orchard at Roswell, New Mexico, on the same trip. It, too, was all uncultivated. It had a very fine crop of apples, but it simply proved that that part of New Mexico, like many other new sections, will raise very fine apples. In the course of a few years those who continue to raise apples in that

way will make considerably less money than those who cultivate. It has been so everywhere it has been tried, and with every kind of fruit. There is no reason why any section should be an exception. It is as plain as can be that the soil needs aerating as well as moistening. It is certain that good stirring will retain most all the moisture until the roots take it out; it is equally certain that it flies out rapidly under a hot sun where it is not stirred, and especially where it bakes to a hard crust after flooding. Cultivation, therefore, saves that much water and keeps the soil in a more uniform stage of moisture, which is exactly what everything needs. There is, therefore, no excuse but laziness for neglecting it, and the man who tells you it is not needed is not a benefactor, but one of those smart fools who never think about running to the patent office to see if any one has been ahead of them with their new discovery.

Cultivation after irrigation needs a machine that stirs and pulverizes instead of turning up the moisture, as a weed-killing cultivator generally does. It wants teeth instead of shovels, and plenty of them. Disks pulverize well but do not stir enough. Such a machine should be light and easily handled, and made to turn easily without injuring trees, and also easily raised or lowered to run deep or shallow, as needed. The Killefer cultivator, made at Los Angeles, has been devised expressly to meet this demand, and seems to do the work better than any other. But almost anything is better and quicker than a common shovel cultivator, such as is made for killing weeds. The other will keep the weeds out if used enough, while the shovel brings up too much moisture and runs hard.



SOME RECENT DECISIONS RELATIVE TO WATER RIGHTS.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN the case of *Moyer vs. Preston*, 44 Pac. Rep., 845, the Supreme Court of Wyoming held: That the common law doctrine of the rights of riparian owners to the waters of natural streams being inapplicable to the requirement of the land owners of Wyoming, was not in force in that state. And further, that Section 1317, providing that persons owning land in Wyoming bounded on or in the neighborhood of a stream shall be entitled to the use of the water of the stream for the purpose of irrigation, does not entitle such owners to claim the water of the stream as riparian owners as against prior appropriators.

In the same case as above, the court held: That the owner of land on which was situated a spring, the waters of which were tributary to a stream flowing through the land, worked several days in 1885 clearing out that spring and facilitating the flow of the water to the stream, and in 1886 again worked one day in clearing the spring, with the intention of appropriating the waters for irrigation, no further work of appropriation being done until 1887, was not an appropriation of the water as against a person prosecuting his work of appropriation in 1886.

CLAIM OF APPROPRIATION—REASONABLE DILIGENCE—USER.

In the case of the *Nevada Ditch Company vs. Bennett*, 45 Pac. Rep., 472, decided by the Supreme Court of Oregon, the facts were as follows: In the early summer of 1881 persons claiming an appropriation of water from a public stream posted a notice at the head of the proposed ditch, as required by local custom, stating the amount of water claimed, the purposes for which it was to be applied, and the route and terminals. Work was begun shortly afterward, and a dam was built and a diversion made for the purpose of aiding in the excavation. The first section, two miles long, was completed in the spring of 1882. During 1882 the ground

was cleared for the excavation of the second section to the further terminal. In the spring of 1883 the work was prosecuted till the irrigation season, when it was stopped to permit the use of water through the completed portion. It was resumed in the fall, and continued until the completion of the second section, in the spring of 1884, and during that year water was run through the full length of the two sections, a distance of about nine miles, and used for irrigation purposes.

The action was one brought by the plaintiff above named to determine the quantity and priority of plaintiff's appropriation of water from the stream, and to restrain defendants from interfering with its use. It was held by the Supreme Court that the plaintiffs had exercised due and reasonable diligence in the prosecution of the work, and that in such a case the appropriation dates back to the first steps taken in the construction of the ditch.

It was also held that a claim to a water right ripens into a valid appropriation only when there is an actual user for a beneficial purpose, and that the claimant is entitled to a reasonable time, after he has diverted and carried the water to the place of use, in which to make the actual application to the contemplated useful purpose, using reasonable diligence under the circumstances of the case.

TRANSFER OF CLAIM.

In the case last cited it was also held that where a person who initiated the appropriation, but has not yet completed it, transfers the possessory title to which the water right was appurtenant, his successor can complete the appropriation.

And also that the *bona fide* intention which is required of the appropriator to apply the water to some useful purpose, may comprehend a use to be made by or through another person, and upon lands and possessions other than those of the appropriator.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, cornerbarns, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

STRAWBERRY CULTURE UNDER IRRIGATION.

BY F. C. BARKER, OF NEW MEXICO.

THE strawberry calls for a special system of culture where irrigation is practiced. In very few localities will matted rows be successful. If the beds are flooded most soils will cake to such an extent that cultivation in the matted rows will be most difficult, if not altogether impossible. On the other hand, many soils are so deficient in porosity that the plants in the middle of the rows will be left dry if the furrow system of irrigation be followed. It is also difficult to properly mulch strawberries in the matted rows so as to keep the berries out of the mud.

The system of planting on narrow raised beds, with wide water furrows between, is popular in small gardens, as, by setting the plants just above the water line, the berries are raised above the mud. Cultivation, however, is tedious, and in the event of any scarcity of water the plants suffer terribly.

On the whole, I am inclined to favor hill culture and the flooding system of irrigation, the plants being set on the flat.

In my own case I have adopted the following method with success: The land is cleared of rubbish and lightly plowed in the late fall or early winter, and any apparent irregularities in the surface made level with the scraper. During the winter stable or cow manure, or, indeed, any kind of manure that is procurable, is carted on to the extent of not less than sixty loads per acre. This quantity may appear excessive to some farmers, but it must be borne in mind that three crops will be taken from the land before it is again fertilized. Most of my own land received more than double this quantity of manure. Wood ashes are also an excellent fertilizer,

and so are ground bones, where they can be obtained. For my own part I am a great believer in stable or farmyard manure, as it improves the mechanical condition of the soil and the humus, in which our soils are naturally deficient, is not only beneficial to the plant but it tends to hold moisture.

Having carted on your manure and spread it, plow it under and give the land the heaviest irrigation you can manage. The object of this irrigation is to rot the manure and enable you to give the final and deeper plowing. The winter irrigation will also enable your land to better stand the droughts of summer.

When the land gets sufficiently dry to work, which will be in about two or three weeks, and before it gets too hard, plow as deep as ever you can, following with a subsoiler. Then drag or harrow so as to break up clods and get the land smooth.

Now, lay out the land in small oblong beds, say not over thirty feet wide by ninety long. It will be difficult to get the water over larger beds quickly and evenly. The water must not be allowed to run from one bed to the other, but lateral ditches must be run to irrigate a row of these beds on each side, the water being let in by small boxes or water gates, say 6 x 4 inches inside measurement. Each bed must be most carefully leveled by means of a spirit level, so that there be no greater fall than two inches in ninety feet. Indeed, if absolutely level they will be all the better. This leveling is of the greatest importance; if not properly done the plants will be standing in muddy water at the lowest point and the berries ruined. The more efficient method of leveling small beds is to run a row of small stakes, the tops of which are placed on a level with the spirit level, down the middle and across. The height at which they stand above the sur-

face will at once show any inequality in the land, and this in small beds can generally be easily rectified by means of a hoe, shovel and wheelbarrow, or a horse scraper may be used.

After the beds are properly leveled give a thorough irrigation about ten or twelve days before you expect your plants. This will put the land in a proper state of moisture to receive the plants and also enable you to see if your leveling has been true. If the land allows the water to stand over an inch and a half in any place you will have to level up again. Planting will be facilitated if the land be harrowed and the surface left in good tilth after this irrigation.

In setting out the plants, take a stout cord, such as carpenters use, and of the length of your beds. At the distance of every sixteen inches mark the cord with a piece of string of a different color by inserting in the cord and tying a knot. The rows are to be sixteen inches apart, and if the cord be so placed that the rows all start on a line, and a plant set at each knot, you will have your plants running in straight lines and at a distance of sixteen inches each way. This is to enable you to cultivate each way, using a Planet, junior, hand or wheel hoe, two of which will cultivate very nearly as many plants in a day as will a horse, and at no more expense. It is true the horse will get over much more land, but the plants will have to be thirty inches each way, and he will never do such careful and thorough work as the man. These wheel hoes are quite indispensable on any strawberry or vegetable farm.

Plant the front row sixteen inches from the border. Then plant two rows and miss a row; then plant four rows and miss a row, and so continue across the bed. If your beds are thirty feet across, or say twenty-eight feet clear of the borders, you will have two rows at each side and three beds of four rows each in the center, with four alleys thirty-two inches wide to enable you to get at the berries, when you want to pick them. Each bed will take 1,056 plants, or 17,000 to the acre.

In planting, I have found nothing equal to a spade. It is thrust into the ground its full length and the handle pushed about a foot away from the worker, which leaves a most convenient wedged-shaped hole for the plant, against the upright

side of which the roots can be easily spread. It is six times faster and more efficient than a trowel.

Subsequent cultivation consists in keeping the soil at the roots constantly moist, but not too wet, and giving a cultivation after each irrigation with the wheel hoe. An occasional hand-hoeing will be necessary where weeds are growing too near the plants to be reached by the wheel hoe, and of course all runners must be kept off the plants, and just before the fruit appears a mulch of straw, or some other suitable material, must be laid between the rows in order to keep the berries out of the mud.

PRACTICAL VALUE OF SPRAYING.

AT a recent meeting of the Western New York Horticultural Society, in Rochester, the following experience was recited:

Mr. Albert Wood, of Orleans county, said he had an apple orchard of twenty-five acres on a gravelly loam. The trees were too close at two rods apart. The shaded ground became mossy; the red apples showed little color. He went through the orchard and cut out every other tree six years ago, since which time he has cultivated and fed those that were left. In 1893 he sprayed two trees; on these the apples were good, while most of the others went to the dry house. On the 20th of April, 1894, he sprayed his orchard, except fourteen trees left for comparison, with twenty pounds of copper sulphate, four pails of lime and 150 gallons of water. He sprayed again as the buds were swelling, and again when the apples were half an inch in diameter. About this time the apples on the unsprayed trees began to drop. With the last two sprayings he used Paris green—one pound to each 150 gallons of water. On the fourteen trees not treated the foliage was rusty. The thirty-five barrels of fruit he picked from them shrunk five barrels between picking and selling. Of the 2,000 barrels of treated fruit the shrinkage was not five barrels in the same time, and they brought thirty-eight cents more a barrel. On a strawberry apple tree that had not had a perfect apple in nine years, every apple was sound. Similar results were had with King, Baldwin and Twenty-ounce trees. Of Roxbury russets three-fourths of the untreated apples were ground for cider, while most of those treated were good. Roxburys should have five sprayings a season.

Pears were treated in the same way as the apples. Some Virgalieus had borne no perfect fruit for twenty-five years, and this year, when sprayed, there was no imperfect fruit. His results showed ninety per cent. gain by spraying. In a young orchard-row not treated the leaves fell three weeks earlier, and the foliage was not as heavy as on the sprayed trees. He had similar results with treated and untreated cherry and plum trees. From Fay's currants which had been sprayed he picked fruit twenty days

after others were gone. He thought the Bordeaux mixture should be applied as a mist, and that the Vermorel nozzle was best except for the higher trees, where the McGowan was the best. A tree should be sprayed till it drips. You cannot throw Bordeaux mixture far when reduced to a fog, and, therefore, for large trees long bamboo poles must be used to hold the nozzle close to the foliage. He used 900 pounds of copper sulphate for thirty days' spraying.

PHYLLOXERA IN THE SOUTH AFRICAN VINEYARD.

A CORRESPONDENT writing from Stellenbosch, Cape Colony, South Africa, to an Australian contemporary, says:

About 300,000 cuttings of American vines will arrive here in the course of next month, to be distributed among the vine-growing population. Phylloxera spreads without any intermission, the devastations are so vast as to be almost beyond belief; some infections exist where the vines die off by thousands. It is a pleasure, though, to write of the great successes obtained in the grafting of vines which develop with unexpected rapidity. I have obtained with green grafting most astonishing results; those grafts, the stocks of which were planted last year as unrooted cuttings, are now over five feet high, and have five and even more well developed bunches of grapes to show. It is still more astonishing that they are on the site where the old vineyard died out, and the new plantation took its place at once.

BISMARCK TO THE FARMERS.

BISMARCK must have taken to farming for profit since the emperor relieved him as chancellor. At a recent meeting of German agrarians the old emperor-maker is reported to have said:

Husbandry is the first-born, but it is not the most favored trade, because farmers cannot live in the towns, and consequently they have not much influence in making the laws. We must stand shoulder to shoulder against the drones who govern us and produce nothing but laws.

A Red Cedar Log, twenty-three inches in diameter, is reported to have been penetrated by a well auger near Lytle Creek, San Bernardino county, Cal., recently, at a depth of 194 feet. Another tree of the same kind was found sixteen feet further down, or at a depth of 210 feet below the surface. No red cedar is now growing anywhere in the county.

World's Commerce.—From a bulletin of the Department of Agriculture concern-

ing the world's markets for American products, we learn that the present commercial rank of nations is as follows: United Kingdom, United States, Germany, France. The foreign commerce of the United Kingdom is about equal to that of the United States and Germany combined, while the difference between the trade of the United States, Germany and France is not very great, the countries ranking in the order named.

Machinery and the Employed.—No doubt the prevailing belief is that the advent of machinery in almost every department of human industry has had the effect to reduce the percentage of persons engaged in gainful occupations, relatively to the whole mass of people. Col. Carroll D. Wright finds, however, by a careful study of statistics that such is not the case. Thus, he finds an actual increase of over 11 per cent. in the thirty years—1860–1890.

The Atthouse Valley in southwestern Oregon is a well irrigated section, largely devoted to the production of hay. Comparatively little grain is grown there, but fruits, garden truck and hay always command good prices at the various mining camps in the vicinity. That part of the state has long been known as a rich gold placer mining region, and considerable activity is manifest in the development of mining enterprises.

Growing Tea.—Dr. Shepard, of Pinehurst, South Carolina, has about forty acres devoted to tea plants, according to a writer in the Country Gentleman. The plant, as grown by Dr. Shepard, is a shrub about three feet high, and the plants are placed in rows about six feet apart.

Good Roads.—Col. F. V. Greene, of the army, in an address at Union College recently, alleged that Massachusetts expends at the rate of \$66 per mile on her wagon roads each year; New Jersey \$43 and New York \$30. Colonel Greene estimates that the other states expend an average of \$18 per mile on their wagon roads, or a total of \$20,000,000 annually, a large part of which is wasted.

Not Self-Supporting.—Doubtless the farmers of Indiana have been too busy raising wheat for the Liverpool market in competition with the peons of Argentina to bother themselves with providing a home supply of cabbage and potatoes. In this connection the Indiana Farmer says:

It is well to repeat the fact to our readers that we are importing altogether too much produce from other states into Indiana. A few days ago one of our commission firms received a car load of cabbage from Maine, two car loads of potatoes from Michigan and one each from two other states. We surely ought to grow enough vegetables for our own use. Potatoes seldom fall below a paying price here, and there seems to be no valid reason why our farmers should not grow at least enough for home supply.

A Well-Known Horseman has discovered a fact in natural history which may not be generally known. It is that all four-footed beasts, in making the first movement in walking, running, or any sort of forward motion, always employ the left hind leg as a starter. Even a child, if put down on all fours and bidden to advance in that position, will make the first move with his left leg, his hands at the same time occupying the place of an animal's forelegs, says the Southern Stock Farm.

Apple Borers.—The Canadian Horticulturist gives the following remedy for apple tree borers:

When borers get into a tree there is no other remedy than cutting them out with a sharp knife, or killing them in their burrows with a stout wire. But prevention is better than remedy, and the injury from borers can easily be prevented. To do so, wash the trunks and larger branches with a mixture of soft soap reduced to the consistency of thick paint with a solution of washing soda. If just enough carbolic acid is added to give it a strong smell it will be all the more repulsive to the beetles. This should be applied during the early part of June and again early in July, when the beetles are most active in laying their eggs.

New Prolific is the name of a peach of recent introduction in Michigan, and is alleged to be very hardy and a liberal bearer. Mr. G. R. Agnew, of Erie, Mich., recommends it highly, and says that his future plantings will comprise 60 per cent. New Prolifics.

South Dakota can raise wheat at a cost of \$8.75 an acre, including \$1.52 for ground rent, which is lower than in any other State. Yet in that State the average crop will not pay that cost at present selling prices.

Foreign lemons are being shipped into New York in such quantities and are selling so cheaply that the California growers have abandoned the Atlantic coast markets and will push their sales in the interior West.

There were 63,485,413 passengers carried over the 10,500 miles of railway in Illinois last year, with a loss of only twelve lives, or one out of 5,290,451. The number injured was as one to 409,583.

Mexico shipped four hundred carloads of oranges to the United States last year, and six hundred loads during the season just ended. The loss of the Florida trees made this possible.

It requires 15,000,000 cows to supply the demand for milk and its products in this country, and the products of 60,000,000 acres of land to feed them.

In 1830 the whole tonnage of Great Britain was but 2,600,000. To-day the tonnage register shows 6,000,000 tons of steam and 5,000,000 tons of sailing vessels.

Delaware has the largest peach crop since 1875, about 6,000,000 baskets, and growers have offered them as low as 25 cents a basket.

Montana heads the list this year as to the number of sheep, followed by California, Ohio and New Mexico in the order named.

The State farms in North Carolina, where the convicts are employed, have 5,000 acres in corn and 4,000 acres in cotton.

The number of sheep in the country has decreased in the last two years from 55,000,000 to less than 43,000,000 head.

There are more than 500,000 telephones in use in the United States, and they are used more than 2,000,000 times daily.

The consumption of cheese is apparently decreasing. It is held to be a luxury, and the hard times tells against it.

Vessels drawing twenty-three feet of water can now enter Sabine harbor with perfect ease and safety.

PULSE OF THE IRRIGATION INDUSTRY

IMMIGRATION AND IRRIGATION.

BY BENJ. W. THOMPSON.

IN the August number of *THE IRRIGATION AGE* the relation of these factors to each other was tersely stated in two or three sentences.

It is quite surprising that in actual practice it has required a succession of disastrous experiences to make men see that irrigation without prompt and extended settlement of the lands leads directly to failure.

Immigration from the old world has been greatly foreshortened by the depressed condition of the country since 1893.

The same cause has stimulated the desire to change place among our resident American people, but it has also prevented large migrations to irrigated lands, because people have been entirely unable to realize cash for their possessions and so could not move.

Settlers upon irrigated lands require at least a small amount of capital and some knowledge of that class of farming.

Hence the question of ability to people the new areas with suitable tillers of the soil is becoming prominent in every new and unfinished canal proposition.

The cautious capitalist is coming to understand the relation of this factor to success or failure and new enterprises will have to demonstrate their ability to provide population before they can borrow money to build.

There have been some examples in Arizona which may contain instructive lessons for coming canal promoters and builders.

The Florence canal was built in good times by parties with money and ability to borrow. The land covered, known as the Casa Grande Valley, is very excellent in quality and much of it ideally located for irrigation. Florence was a growing town and the lands under the canal reached to the Southern Pacific railroad, giving them an outlet. The canal was completed and put in operation while the country was prosperous.

But in a short time it failed, bringing ruin upon its principal owners because its

income was insufficient to pay its fixed charges and expenses.

The reason of the failure seems very plain. No adequate effort was made to procure settlers for the lands. The projectors seem to have taken it for granted that people would rush in and take up the lands as soon as it was known that they could be irrigated.

It is quite probable that this would have been true if the public had been thoroughly informed by judicious advertising of the advantages of this new field.

In the absence of this information the general public practically knew nothing of this new canal and took no interest in its lands.

The Arizona canal in the Salt River Valley, Arizona, was built earlier than the Florence. The lands under it were all taken up by the time the canal was finished.

Through the operation of the very liberal desert land law of that time quite a large proportion of these lands came into the hands of the principal owners of the canal stock. The canal became to this extent a private land speculation.

The withholding of so large a portion of the lands from profitable contribution to the fixed charges and expenses of the canal retarded its growth and debt paying power. In times of damages from floods they were compelled to borrow and draw from personal resources to meet emergencies.

Because of the near location of the lands to the large town of Phoenix, of good times which prevailed for six or seven years after its completion, the principal owners were able to carry the load and sell quite an amount of the lands at a handsome advance on their cost.

The experience, however, was a hazardous one, and at other times and circumstances might readily have ended very unfavorably.

The co-operative canals of the Mormon's on the south side of the Salt River were built upon a plan which combined safety and success with entire fairness and justice to all parties interested.

These people, after discovery of the place and deciding to build, sent forward their men and teams with a few families to board the workers, and began the work. A part of the teams procured work from the government hauling supplies and wood to Fort McDowell and so furnished the ready money for such supplies as had to be bought for cash. Putting a brush and stone dam into the river they soon had a small supply of water and began to raise their food and forage. The population was increased as rapidly as there was room for them, a certain portion being kept at work upon the canal.

Thus in a few years they had a completed ditch and were all owners in fee of their lands and the canal.

The main objections to this system for general application is that the bringing of water to irrigate the best and safest locations, requires so large an outlay for dams and other expensive works that ordinary co-operative communities are entirely unable to accomplish the results.

Capitalists will not entrust the management of their investments to a vote of a town meeting, but require either personal control or responsible ownership and management.

There is no probability of canals being built by our general or state governments, as such improvements have been made in India and lands reclaimed in Holland.

It follows, therefore, that our great canals will be built, owned and managed by stock companies.

The plan that comprises the greatest number of elements of safety and fairness is the very simple one of encouraging all settlers to take lands under the canal from the government at one and one-quarter dollars per acre. This the desert land law makes very easy.

The canal company should confine its business strictly to selling water rights and serving water.

This gives the settler a fair share of the increase of value to the land from settlement and irrigation, while the canal company will have a safe and definite return from its investment.

In order to accomplish this happy combination, there must be a constant, liberal and judicious use of printers' ink.

The Rio Verde canal of the Salt River Valley has adopted practically the above plan and nearly half its lands are taken up already while the canal is not half constructed.

KENNEWICK VALLEY, WASH.

The farmers of this valley seem to be satisfied with the crops they have harvested this season, and if prices were good would receive ample return for the labor expended. All kinds of crops grown under irrigation this season have done remarkably well.

Quite a large acreage of sorghum was planted, and where well cared for shows very large growth, some fields showing a growth of 14 feet in height and an average of 12 feet. Three sorghum mills are now at work and will turn out several thousand gallons of very fine syrup.

Mr. M. D. Oslem has just harvested and distilled 20 acres of mint. Thinks the crop is very encouraging, giving a very fair return for the year's work, considering the expense of putting in a still and other necessary work to get started. The returns are this year sufficient to warrant largely increasing the average if the question of the supply of water for irrigation is satisfactorily settled, saying that he would plant out 40 acres this fall, making 60 acres for another year. Mr. Oslem came from Michigan where he was engaged in mint culture. Thinks this country far ahead of Michigan for this purpose. The young fruit orchards have made a very fine growth this season, giving the farmers a little fruit. Next year quite a crop of fruit can be expected.

The wheat crop of Eastern Washington has turned out considerably better, on the whole, than expected. Quite a rise of prices which has taken place of late caused considerable shipments at 45 cents per bushel, making the wheat growers look more cheerful.

NEBRASKA STATE IRRIGATION ASSOCIATION.

The executive committee has found it necessary to postpone the meeting of the fourth annual convention of the Nebraska State Irrigation Association to be held at Lexington, Nebraska, from the 7, 8, 9th of October till the 19, 20, 21st of November. The selection of these later dates was thought to be essential to the most complete success of the meeting. There were conflicting meetings and engagements of a large number who were particularly anxious to attend, and the change was made by unanimous decision of the local executive committee at Lexington after due deliberation.

Extensive preparations are being made by both the state and executive committee and the local executive committee at Lexington for a convention of the highest order as to state and national talent and the most needful information of a practical nature will be the central idea in preparing the program.

MORE DELEGATES.

The following is a list of the delegates appointed by the governors of the various states and territories since the list announced in our September number:

Colorado—Capt. W. A. Glassford, A. B. Moulton, C. L. Richards, all of Denver; Henry J. Arnold, Durango; Hon. David Boyd, Greeley.

Oklahoma—W. F. Bort, Kingfisher, in place of J. V. Admire, who is ex-officio a member.

INTERESTING ITEMS.

Oregon has 25,000 acres of prune orchards.

In France, when a railway train is more than ten minutes late, the company is fined.

Distilling sweet potatoes for alcohol and whiskey is a new industry in the South.

The United States consumed last year more than 4,000,000 bunches of Jamaica bananas.

It is estimated that drouth in New South Wales has caused the loss of 9,500,000 sheep.

WHAT SOME OF ITS READERS SAY ABOUT THE IRRIGATION AGE.

I have received only the one number so far, and as I would not take \$5 for that, would like to get the others.

B. B. DeNure, Vekol, Ariz.

I consider THE AGE a very interesting magazine for the whole country, as well as the West.

EDWARD L. BARTLETT,
Santa Fe, N. M.

I don't want THE AGE stopped.

J. S. BARNES, Banker,
Pratt, Kansas.

THE IRRIGATION AGE is without question the best publication on irrigation matters, and I prize it very highly.

A. A. BATCHELDER,
Pasco, Wash.

THE AGE is good. JOHN A. BENSON,
San Francisco, Cal.

THE AGE has been a welcome visitor at the public library for some time, and is highly valued by all our patrons.

B. H. BARROWS,

Librarian Public Library, Omaha, Neb.

You do indeed publish a nice looking and very interesting monthly, and I think it fills a long-felt want, and will help to solve the problem of population and immigration for Nebraska and the central West.

GEO. P. BEMIS,

Ex-Mayor of Omaha, Neb.

I highly appreciate the good work THE AGE has done, the contents of which I have always valued.

E. W. BLACK,

North Loup, Neb.

I hasten to send you \$1 for renewal of my subscription to THE AGE, as I am well pleased with it, and also much interested in windmill irrigation on the plains. I firmly believe that it is our only way toward a successful solution of permanently settling this section of Kansas, as well as many other sections of the plains country.

JOHN E. BRETZ,

La Blanche, Kansas.

I have enjoyed THE AGE very much, and would not do without it for four times its cost.

J. K. BREEDEN,

Fort Pierre, So. Dak.

THE IRRIGATION AGE is indispensable and is a very valuable paper. DR. J. B. BURNS,
Plymouth Colony, Payette, Idaho.

I consider your work the best thing in its line that I have ever seen, and I hope you will be able to continue on the lines already established by your publication. Every man interested in irrigation should read THE AGE.

WM. BUTTON,

Minneapolis, Minn.

I hope you will meet the success your truly valuable paper deserves.

F. F. COLLINS,

Pres't F. F. Collins Mfg. Co.,
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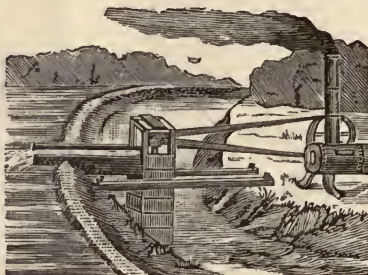
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The Chicago, Milwaukee & St. Paul Railway Company owns and operates 6,154 miles (9,900 kilometers) of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle. Many towns on the line are prepared to treat very favorably with manufacturers who would locate in their vicinity.

Mines of coal, iron, copper, lead and zinc, forests of soft and hardwood, quarries, clays of all kinds, tan bark, flax and other raw materials exist in its territory in addition to the vast agricultural resources.

A number of new factories have been induced to locate—largely through the instrumentality of this company—at towns on its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway, makes it possible to command all the markets of the United States. The trend of manufacturing is Westward. Nothing should delay enterprising manufacturers from investigating. Confidential inquiries are treated as such. The information furnished a particular industry is reliable. Address

LUIS JACKSON,

Industrial Commissioner, C. & M. & St. P. R'y.

425 Old Colony Building, CHICAGO.

MENTION THE IRRIGATION AGE.

The Pecos Valley of New Mexico.

The part of the Pecos Valley which The Pecos Irrigation and Improvement Company has undertaken to reclaim by irrigation, is situated in southeastern New Mexico, extending into northwestern Texas, and comprises a large area of as highly productive agricultural and horticultural land as can be found on the American continent. At intervals along the Pecos River, for a distance of 165 miles, have been constructed dams, reservoirs and canals, furnishing an abundant and unfailing supply of water for 400,000 acres, over one-half of which area is already covered by the canals. The reservoirs have a total capacity of 6,300,000,000 cubic feet of water; the canals, with the main and laterals, have a total length of 1,500 miles. About 75,000 acres are already in the hands of settlers, of which over 25,000 acres are in actual cultivation, 2,500 acres being in orchards and vineyards. To further develop this region, a standard gauge railway, 164 miles long, has been built through the entire length of the Valley. Towns and villages have been started, of which Eddy and Roswell are the largest, the former having about 2,500, and the latter about 2,000 inhabitants. Hagerman, Otis, Florence, Francis and Malaga are also growing villages. This work was undertaken a little over seven years ago, and has already cost over four millions of dollars. The Pecos Valley now ranks as the largest irrigation enterprise in America, and one of the largest in the world.



A THREE-YEAR-OLD APPLE TREE IN THE PECOS VALLEY.

Soil, Climate and Productions.

The soil of the Pecos Valley is, in the main, a sandy loam, and is of remarkable depth and richness. The climate is warm and sunny, practically winterless, with long growing seasons, and likewise possesses wonderful health-giving and health-restoring properties, especially for pulmonary and many other chronic diseases. This soil and climate, with the abundant water supply, unite to produce bountiful crops of all the grains, grasses, berries, vegetables and fruits of the temperate zone. Such forage crops as alfalfa, sorghum, Indian and Egyptian corn grow most luxuriantly, making the feeding of cattle, sheep and hogs a most profitable industry. The sugar beet attains a perfection not reached elsewhere in the

United States, if in the world. A beet sugar factory, with a daily capacity of 225 tons of beets, is now being built at Eddy, and will be in operation November 1, 1896. To supply this factory the farmers of the Valley are now putting in fully 2,500 acres of beets, for which the sugar factory has contracted to pay \$4 per ton delivered at any station on the Pecos Valley Railway, the company paying the freight to the factory. At this price, and with the large yield per acre in the Pecos Valley, the farmer should clear all the way from \$35 to \$75 per acre from his crop of beets.

In the raising of fruits the Pecos Valley will take its place among the most highly favored sections of our land. All the standard fruits of the temperate

zone are successfully raised, while several of these attain a perfection rarely equaled and nowhere surpassed. At the head stand the apple and pear, closely followed by the peach, grape, nectarine, apricot, plum, prune and quince. All the small fruits grow in abundance. The fruits of the Pecos Valley are without blemish, superb in form and coloring, and of unequalled flavor. In a few years they will be found in all the great markets of the country, commanding topmost prices because of their beauty and perfection.

Social and Educational.

The Pecos Valley is being settled in the main by progressive and intelligent people, the majority being Americans, mainly from the Central West. As a result, schools and churches are found in every town and village in the Valley.

The Pecos Valley, while attracting the general farmer and fruit-grower, holds especial attractions for those whose health requires an outdoor life in the dry, elevated region of the Rocky Mountain plateau; and these will there find not only the health they seek, but profitable occupation as well. Not only does this life appeal to the health-seeker, but also to the thousands all over our land, and especially in our large cities, who wish to exchange the life of grind and drudgery and narrowing industrial conditions, for one of independence and a larger hope for the future.

For prices of land, and terms, with copies of illustrated publications, address The Pecos Irrigation & Improvement Co., Eddy, New Mexico.



MOUNT SHASTA IN CALIFORNIA
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THE IRRIGATION AGE.

VOL. X.

CHICAGO, NOVEMBER, 1896.

NO. 5.

PROGRESS OF WESTERN AMERICA.

The Wright Law Decision rendered.

The all important decision on the constitutionality of the Wright Irrigation District Law has been rendered, and as this comes from the Supreme Court of the United States there can be no further dispute as to main points of the law, that the use of water for irrigation is a public use. The decision in the case of the Fallbrook Irrigation District vs. Maria King Bradley, et al. has been awaited with great anxiety for many months. After passing out of the jurisdiction of the State Courts it was taken to the United States Supreme Court on a question of constitutionality and attracted wide attention among Eastern people, who were just beginning to realize the importance of irrigation, on account of ex-President Harrison delivering an argument in its favor. The case was closed about a year ago and the decision expected immediately but through some peculiarity of the Supreme Court it has been withheld. It is a matter affecting bonds with a face value of about ten millions of dollars, and applies not only to California but to many other states, which followed California's lead and adopted the district system.

The Decision. A portion of the decision as rendered by Justice Peckham on November 16 follows:

To provide for the irrigation of lands in states where there is no color of necessity therefor, within any fair meaning of the term, and simply for the purpose of gratifying the taste of the owner, or his desire to enter upon the cultivation of an entirely new kind of crop, not necessary for the purpose of rendering the ordinary cultivation of land reasonably remunerative, might be regarded by the courts as an improper exercise of legislative will, and the use might not be held to be public in any con-

stitutional sense, no matter how many owners were interested in the scheme.

On the other hand, in a state like California, which confessedly embraces millions of acres of arid lands, an act of the legislature providing for their irrigation might well be regarded as an act devoting the water to a public use, and therefore as a valid exercise of the legislative power. The people of California and the members of her legislature must in the nature of things be more familiar with the facts and circumstances which surround the subject, and with the necessities and the occasion for the irrigation of the lands, than anyone who is a stranger to her soil. This knowledge and familiarity must have their due weight with the state courts, which are to pass upon the question of public use in the light of the facts which surround the subject in their own state.

California State Courts Upheld. For these reasons, while not regarding the matter as concluded by these various declarations and acts and decisions of the people and courts of California, yet we, in consideration of the subject, accord to and treat them with very great respect and we regard the decisions as embodying the deliberate judgment and matured thought of the courts of that state on this question. Viewing the subject for ourselves and in the light of these circumstances, we have very little difficulty in coming to the same conclusion reached by the courts in California. The use must be regarded as a public use or else it would seem to follow that no general scheme of irrigation can be formed or carried into effect.

To irrigate and thus to bring into possible cultivation these large masses of otherwise worthless lands would seem to be a public purpose and a matter of public interest; not confined to the land owner, or even to any one section of the state. The fact that the use of water is limited to the land owner is not, therefore, a fatal objection to the legislation. It is not essential that the entire community, or even any considerable portion thereof, should directly enjoy or participate in an improvement in order to constitute a public use. All land owners in the district have the right to a proportionate share of the water, and no land owner is favored above his fellow in his right to the use of the

water. It is not necessary, in order that the use should be public, that every resident in the district should have the right to use of the water.

The method of assessment here provided for may not have been the best which could have been adopted in order to accomplish the most equal and exact justice which the nature of the case permits. But, nevertheless, we are unable to see that it runs counter to any provision of the federal constitution, and we must for that reason hold the objection here considered to be untenable.

The Final Outcome. Owing to the very late date in the month when the decision was handed down it is impossible in this issue of *THE AGE* to review the matter as fully as would have been liked, but it may safely be stated that the end of the difficulty has not yet been reached. The opponents of the law will undoubtedly make an earnest effort to erase the law from the statute books of California and thus prevent the organization of any new districts, and there is also to be considered the difficulties the bondholders will meet in attempting to realize on the obligations they hold. The opinions of the most active workers in behalf of the irrigation cause will be presented in the next number.

Judge Ross on Water Rights. But while considering the great importance of the decision on the Wright Law, the equally important decision of Judge Ross of California on the question of water rights must not be overlooked. In the case of Charles D. Lanning receiver of the San Diego Land and Town Company vs. H. S. Osborne, Judge Ross decided that where water has once been devoted to public use the right of the supervisors under the Constitution to fix water rates cannot be affected by private contract. A few extracts from the lengthy opinion are given herewith, but stripped of its legal phrases and technicalities it means that irrigation and canal companies are not privileged to sell water rights, but can demand only a reasonable compensation for the actual transportation and delivery of the water to users, in other words they may make an annual charge per acre for water delivered, but cannot exact a bonus for the right to have that water delivered. This decision, if upheld by the United States Supreme Court where it will undoubtedly be carried (as was Judge Ross's decision on the Wright Law), will remove the matter of irrigation from the

field of speculation and make it an every day business enterprise, in which the individuals and corporations who build, own and operate canals can expect only a fair rate of interest upon the investment; while the immediate effect of the decision will be to prevent the inception of new enterprises and possibly the completion of some already begun, its ultimate effect cannot but fail to be beneficial.

Extracts from California Constitution. At the time of the adoption and taking effect of the Constitution of California of 1879, the provisions of Section 552 of the Civil Code of that State were, and yet are, as follows :

"Whenever any corporation, organized under the laws of this State, furnishes water to irrigate lands which said corporation has sold, the right to the flow and use of said water is and shall remain a perpetual easement to the land so sold, at such rates and terms as may be established by said corporation in pursuance of law. And whenever any person who is cultivating land on the line and within the flow of any ditch owned by such corporation, has been furnished water by it with which to irrigate his land, such person shall be entitled to the continued use of said water, upon the same terms as those who have purchased their land of the corporation."

Sections 1 and 3 of Article XIV of the Constitution of 1879 are as follows:

Section 1. The use of all water now appropriated or that may hereafter be appropriated, for sale, rental or distribution, is hereby declared to be a public use, and subject to the regulation and control of the State, in the manner to be prescribed by law; provided, that the rates of recompensation to be collected by any person, company or corporation in this State for the use of water supplied to any city and county, or city or town, or the inhabitants thereof, shall be fixed, annually, by the Board of Supervisors, or city or county, or city or town council, or other governing body of such city and county, or city or town, by ordinance or otherwise, in the manner that other ordinances or legislative acts or resolutions are passed by such body, and shall continue in force for one year, and no longer. Such ordinance or resolutions shall be passed in the month of February of each year, and take effect on the 1st day of July thereafter. Any board or body failing to pass the necessary ordinances or resolutions fixing water rates, where necessary, within such time, shall be subject to peremptory process to compel action at the suit of any party interested, and shall be liable to such further processes and penalties as the Legislature may prescribe. Any person, company, or corporation collecting water rates in any city and county, or city or town in this State, otherwise than as so established, shall forfeit the franchises and waterworks of such person, company, or corporation to the city and



DRYING PRUNES IN CALIFORNIA.

county or city or town where the same are collected, for public use.

Sec. 2. The right to collect rates of compensation for the use of water supplied to any county, city and county, or town, or the inhabitants thereof, is a franchise, and cannot be exercised except by authority of and in the manner prescribed by law."

Water Right Charge

Not Legal. The late case of San Diego Land and Town Company vs. City of National City decided by this court and reported in 74 Fed. Rep., p. 79, presented the question, among others, whether that company had the legal right to demand and receive a sum of money, in addition to the annual rates it was authorized to charge, as a condition upon which it would furnish water appropriated by it under the Constitution and laws of California, to the persons for whose use the appropriation was made. The thing for which that company demanded a sum of money, in addition to the annual rates it was by law authorized to charge, it designated as a "water right." In that case, this court said: "It does not change the essence of the thing for which the complainant demands a sum of money to call it a 'water right,' or to say, as it does, that the charge is imposed for the purpose of reimbursing complainant in part for the outlay to which it has been subjected. It is demanding a sum of money for doing what the constitution and laws of California authorized it to appropriate water within its limits, conferred upon it the great power of eminent domain, and the franchise to distribute and sell the water so appropriated, not only to those needing it for purposes of irrigation, but also to the cities and towns, and their inhabitants, within its flow; for which it was given the right to charge rates to be established by law, and nothing else. No authority can anywhere be found for any charge for the so-called 'water right.' The State permitted the water in question to be appropriated for distribution and sale, for purposes of irrigation, and for domestic and other beneficial uses; conferring upon the appropriator the great powers mentioned and compensating it for its outlay by the fixed annual rates. The complainant was not obliged to avail itself of the offer of the State, but, choosing, as it did, to accept the benefits conferred by the constitution and laws of California, it accepted them charged with the corresponding burden. Appropriating, as it did, the water in question for distribution and sale, it thereupon became, according to the express declaration of the Constitution, charged with a public use. 'Whenever,' said the Supreme Court of California, in *McCrary vs. Beaudry*, (67 Cal., 120, 121, 7 Pac. 264,) 'water is appropriated for distribution and sale, the public has a right to use it; that is, each member of the community, by paying the rate fixed for supplying it, has a right to use a reasonable quantity of it in a reasonable manner. Water appropriated for distribution and sale is *ipso facto* devoted to a public use, which is inconsistent with the right of the person so appropriating it to exercise the same control over it that he might have exercised if he had never so appropriated it.'"

A Similar Case A similar question did arise in the Supreme Court of Colorado in the case of *Wheeler vs. Northern Colorado Irrigating Company*, (17 Pac. Rep., 487,) and was there decided in precise accord with the ruling of this court in *San Diego Land and Town Company vs. The City of National City* (supra.). The provisions of the Constitution of Colorado were at the time the case cited arose, as follows:

"Sec. 5. The water of every natural stream not heretofore appropriated within the State of Colorado is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereinafter provided.

Sec. 6. The right to divert unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using the water for the same purpose; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.

"Sec. 7. All persons and corporations shall have the right-of-way across public, private and corporate lands for the construction of ditches, canals and flumes for the purpose of conveying water for domestic purposes, for irrigation of agricultural lands, and for mining and manufacturing purposes, and for drainage, upon payment of just compensation.

"Sec. 8. The General Assembly shall provide by law that the Board of County Commissioners in their respective counties shall have power, when application is made to them by either party interested, to establish reasonable maximum rates to be charged for the use of water, whether furnished by individuals or corporations."

Declared Illegal. In the Colorado case, the pleadings showed the water company to be a carrier and distributor of water for irrigation and other purposes, with a canal upwards of sixty miles in length, and capable of supplying water to irrigate a large area of land. It had undisposed of a sufficient quantity of water to supply the wants of the relator, who was one of the land owners and consumers under the canal, and who could obtain water from no other source. He tendered the amount of the annual rental fixed by the company, and demanded the use of water for the current season, but the company demanded as a condition precedent to the granting of his request that he buy in advance "the right to receive and use water" from its canals and pay therefor \$10 per acre—just as the San Diego Land and Town Company, in the case decided by this court, demanded \$50 per acre at one time and \$100 per acre afterward, for a similar so-called "water right." The Supreme Court of Colorado held, as did this court in the case referred to, the demand in addition to the annual rates, for the so-called water right

illegal and void. In the course of his opinion, the justice delivering the opinion of the court said: "Our Constitution dedicates all unappropriated water in the natural streams of the State 'to the use of the people,' the ownership thereof being vested in the 'public.'"

Judge Ross further said: "Under the Constitution, as I understand it, the carrier is at least a quasi-public servant or agent. It is not in the attitude of a private individual contracting for the sale or use of his private property. It exists largely for the benefit of others, being engaged in the business of transporting for hire, water owned by the public, to the people owning the right to its use."

The Homeseekers' Association. One of the most notable occurrences of the past month was the public meeting of the Homeseekers' Association at the Wellington Hotel, in Chicago, on November 24. This association (the objects which are fully explained elsewhere in the issue) has been working for nearly two years and has been of material benefit to a vast number of the people in this city and in other places, but it is now entering upon a period when its usefulness will be multiplied many fold. About seventy-five prominent people were present at the meeting and it was decided to place in the rooms of the Association a permanent public exhibit of the agricultural, horticultural and mineral products of the various states. Definite promises of exhibits were made by the representatives of nine states and conditional promises by many more. The association is donating the necessary office space free

and it is expected that many of the exhibits will be ready for inspection by the middle of December. Two more public meetings will be held during the month of December, at one of which Capt J. M. Wells, World's Fair Commissioner from Idaho, Mrs. Alice Houghton, of the Board of Lady Managers of the World's Fair, and Dr. A. T. Ely, of Kennewick, Wash., will speak on the resources of the Northwest in general and the states of Idaho and Washington in particular. The second meeting will be devoted to Louisiana and the South, with prominent speakers. The association is making arrangements to hold regular meetings throughout the winter and also expects to begin immediately the publication of a series of pamphlets.

Important Matters. No apology is offered for devoting so much space in this department this month to the Wright Law and Judge Ross on Water Rights. No two decisions more vitally affecting irrigation interests have ever been rendered and it is now hoped that within a reasonable length of time the many perplexing problems surrounding this particular industry, which is almost entirely new to the mass of the American people, will be solved in accordance with a sense of justice, and that we will be able to move forward in the reclamation and settlement of our vast arid domain with the knowledge that both those who invest their money and those who invest their time and labor will be entitled to and receive a fair remuneration upon their investment.



THE HOMESEEEKERS ASSOCIATION.

BY G. E. GIRLING.

THE aims and objects of The Homeseekers Association were fully set forth in the daily papers of Chicago and elsewhere at the time of its organization early in 1895, but for the benefit of those not conversant with the matter it will be briefly re-stated :

The Homeseekers Association was organized by prominent clergymen of Chicago for the purpose of furnishing reliable and specific information regarding lands and locations, for settlers, colonists and invalids, to such as wished to avail themselves of this opportunity. The fundamental idea of the Association was broad, comprehensive and philanthropic. It reached over the boundaries of state and section and aimed at the advancement of the nation and the human race. It was conceived in no petty spirit of personal aggrandizement, but was nursed on the "milk of human kindness."

The need of such an association had been (and is now) demonstrated many times. The unfortunate individual who desired to better his condition, or was obliged for health's sake to change his residence, was surrounded on every side by importuning and in many cases unscrupulous land agents, each one of whom claimed to have "*the very best location on the face of the earth.*" With such a mass of contradictory statements before him it is not to be wondered at that the bewildered individual closed his eyes and chose at random, more often choosing wrong than right.

The ordinary home or healthseeker can not afford to spend the necessary time and money to visit and personally investigate the propositions laid before him and he mainly relies upon the word of others in making a selection that affect the whole future happiness and welfare of himself and family. Such a step should not be taken hurriedly or ill-advisedly, but sober, honest judgment should be brought to the task of deciding for each *individual* what would best meet his needs and tastes and requirements.

The Homeseekers Association not being a money making enterprise and having no interest in any particular state or section aims to lay before the inquirer simply the facts as they exist, leaving the individual to decide for himself where he shall locate, The great difficulty to be overcome was in *ascertaining the facts*, and the clergymen who organized the association, being representatives of all denominations both Catholic and Protestant, believed that their brother clergymen in the various part of the country would be better able to express an impartial unbiased opinion on the resources, advantages and possibilities of their particular locality than some who had financial interests at stake. But it must not be understood that clergymen alone will be depended upon to furnish this information.

THE GREAT MIDDLE CLASSES.

The Homeseekers Association aims to interest and educate the middle classes of America and Europe. It aims to implant deeply in their minds the desire for better conditions of average prosperity. The plan is to direct the agitation to the formation of branches of the National body in all parts of the country. The vast preponderance of wage-earning people live in the hope of something better. They are willing to give a hearing to a movement which deals with new institutions, and a hearing is all that The Homeseekers Association aims at.

The branches of The Homeseekers Association if they shall be extensively organized and then properly cultivated in the spirit suggested, will become the means of educating the masses to a proper appreciation of independence in country homes.

LITERATURE AND LECTURES.

The Homeseekers Association will work along the lines of the Chautauqua system, aiming to educate the people through a comprehensive system of literature and lectures. Members will pay the bare cost of providing the book and pamphlets.

A score of the best writers will be invited to co-operate in the preparation of this literature. The same literature will be used by all branch associations and one Board of Editors will suffice. This board will be sufficiently eminent to furnish an absolute guarantee as to the character of the statements put forth.

Such work as this must be above all suspicion of personal or local interest. It must be organized and carried out as a matter of the highest public spirit.

While The Homeseekers Association is not a money making enterprise it does aim to be self-supporting. Its income from memberships must equal its expenses for printing, postage and office assistance; the officers and directors giving their time free. The membership fee is one dollar and the annual dues one dollar after the first year, subject to change by the Board of Directors. The membership fee is pay-

able at the time the application is made and entitles the holder to any information at the disposal of the Association, and to any printed matter the Association may publish. A paid membership in the National body can be transferred without charge to any local branch upon the organization of the same, and the organization of branch associations will be authorized upon application of ten members to the National Association.

The series of public lectures contemplated will be explained hereafter.

During the past eighteen months the association has received many thousands of letters from all parts of the United States, Canada, Mexico, South America, European countries, Australia and India, and these along with a vast mass of statistics and information is being arranged and classified and will be placed at the disposal of members.

THE ART OF IRRIGATION.

CHAPTER XVII. THE AMOUNT OF WATER REQUIRED.

BY T. S. VAN DYKE.

THE amount of water needed for an acre of a given crop is commonly called the "duty of water." It is the most important branch of the whole subject and success or failure for the irrigator will depend greatly upon his comprehension of it. There are many who understand better than I those features of irrigation so far treated. The only advantage I have over them is that they are too lazy to write while I am not. But on the duty of water be careful how you criticise me. For many years it has been part of my business as promoter and builder of some very large irrigation works, where the water was very expensive on account of the high-line aqueducts necessary to reach high land, to prove to the land owners that they could pay what the water was worth. Proving to them what an inch of water under four inch pressure would accomplish was the only way to do it and the only way to prove that was to understand what I was talking about and be prepared to stand a rigid cross-examination on it at public

meetings or at the private button hole. Becoming interested in the subject it became a labor of love and I have probably measured more heads and substracted the tail end waste, have watched more people irrigate and asked more questions, have examined more books of the water companies and lavished more beer and cigars on secretaries and ditch-tenders to get them to show me their water accounts with the different customers than any man living. I know that no one else in California has done so and outside of California full information on the subject is impossible. You cannot place the slightest reliance upon what the majority even of the best irrigators tell you about the duty of water. The most of them do not care and of the few that do hardly one secures or keeps any data and mere memory is of very little use.

ESTIMATED DUTY OF WATER.

The duty of water is commonly estimated by the miner's inch or the cubic

foot a second, but a much better measure is the acre foot or acre inch. This is the quantity needed to cover an acre a foot deep or an inch deep. It brings it to the basis of rain and is more easy to understand. Owing to loss from direct run-off, the coming of rain when not needed and the evaporation from the top soil of quantities too small to be of service it will on an average require two feet of rain as it commonly comes to equal in results one acre foot of water properly applied at the right times and with no more waste than is absolutely unavoidable to ensure wetting of the lower side of the tract.

The amount needed for any given crop is so dependent upon the nature of the soil, the climate, the rainfall and its time and manner of coming with the skill of the irrigator, the perfection to which he wishes to bring the crop, and so many other things that it is very difficult to lay down general rules. But the subject must be understood as far as possible by every one who wants to make much of a success of irrigation.

The duty of water is generally estimated by dividing the number of acres entitled to the water of a ditch by the number of cubic feet a second or inches which the ditch is supposed to carry, alleged to contain or supposed to be capable of carrying if in good condition. This debits the duty of water with all waste and all errors about the quantity flowing. Both of these are very great, especially the waste where the whole capacity of the ditch is not yet called for by the rate of settlement and the loss of water consequently immaterial. You might as well try to find the duty of meat by dividing the number of pounds taken in the kitchen door of a five dollar hotel by the number of guests on the register. When this method is extended to all the ditches in the country, and the area supposed to be under them divided by the water supposed to be in them all, we get the charming figure of about fifty-four acres to a cubic foot a second. This will cover an acre about fourteen feet deep. While our esteemed Department of Agriculture no doubt does the best it can with the data available the monstrous absurdity of the conclusion should be so patent as to forbid its publication. It can only mislead people into thinking irrigation out of the question in thousands of places where it can be used

to great advantage. Nothing could discourage the investment of capital in irrigation works like the belief that any such quantity of water is necessary and no one would want to irrigate if he had to put on fourteen acre feet even in a whole year. Nothing but coarse sand or gravel could take any such quantity without making a swamp of the place, while ground fine enough to be worth cultivating at all never needs over one-third of that amount even in the hottest countries where the rainfall is practically nothing. Waste is sometimes justifiable where water is plenty because it may save labor. It may pay to turn a large stream into furrows so as to force the water through quickly while you do something else instead of standing there to coax it. But this is waste and should not be charged against the duty of water. The future prosperity of the west is bound up in the development of water and the farther it can be proved to go the easier it will be to get the needed capital.

The uncertainty as to the duty of water is farther increased by the common way of counting *by the rate* at which water is used during a certain period called the "irrigating season" and not by the quantity actually put upon the ground during the year. This irrigating season varies so with the locality, the climate, rainfall and products as to increase the uncertainty.

WATER ON TEN ACRES.

Here is the water amount of a ten acre tract in miscellaneous stuff in one of the most prosperous settlements of Southern California. It is taken from the books of the company and shows exactly the number of twenty-four hour inches put on the tract that year. The water right was one inch to ten acres.

May..	thirty inches...	twenty-four hour's run.
June..	forty-five inches...	sixteen hour's run.
July..	thirty inches...	twenty-four hour's run.
August....	sixty-inches...	twelve hour's run.
Sept....	forty-five inches...	sixteen hour's run.
October....	sixty-inches...	twelve hour's run.

You see that in six months the owner used one hundred and eighty twenty-four hour inches. But under the water-right there was due the tract the equivalent of one-inch for three hundred and sixty-five days. This would be three hundred and sixty-five twenty-four hour inches, where as he used only one hundred and eighty. What then became of the other one hundred and eighty-five twenty-four hour inches?

If the land-owner could have got them during the six months of summer he would have either wasted them or have extended his acreage. Or if he had the place in alfalfa he might have used them all to advantage on the ten acres. But very few companies either public or private could run on such a principle without too great an expense for the water and the size of the aqueducts for its delivery or too great a clash of interest among the irrigators. For an inch of water means the equivalent of an inch for a year taken in heads according to rules for the convenience of all consumers and one of the first of these generally is that one cannot exceed thirty twenty-four inches a month. During the other six months he could have had the other one hundred and eighty-five twenty-four hour inches. Had he used them he could have extended his acreage or used less water on the piece he actually irrigated as shown in the chapter on winter irrigation. But he preferred to take his chances on the clouds doing their duty and let them go to the sea unused—a clear waste of public wealth. If the clouds failed to do their duty then he would need more than thirty inches a month for the summer; but he not only could not get any more, but he might under the rules have to take less; for no ditch can be successfully managed even by the landowner's without making all take shortage sometimes.

MORE ABOUT DUTY OF WATER.

Be careful now and follow me closely for this subject has puzzled many a head.

During the six months the water was used on this ten acre tract it was used *at the rate* of three hundred and sixty-five twenty-four hour inches for the year. But the actual business was done by one hundred and eighty twenty-four hour inches. But as during the six months of actual use it was applied at the rate of an inch to ten acres it is called an inch to ten. The absurdity of this is more apparent by supposing it had been only once, say thirty inches in July. Because used at the rate of an inch it is still called an inch to ten, whereas the quantity actually put upon the ground is but one-sixth of what it was before. According to this in a country needing so little irrigation that once a year would suffice the duty of water would be about the same as in one needing it all the time.

But how are we to get at the duty any other way? Well, at present it is not easy. It is certain that the effectiveness of any water system, as a system, can be tested only by what it will do during that period of the year when most water is needed and vegetation will suffer most if not quickly and fully supplied. That is the way this method of computation arose and remains in fashion. If a stream will furnish a thousand feet a second during the winter when it is not needed, or if people think it is not needed, which for this purpose is the same thing, but will furnish only one hundred feet during the three summer months when the water is most needed and the full capacity of the stream is in demand every day, it is clear that the power of that stream as an irrigating resource is measured almost entirely by what it will furnish during that time.

On the other hand it is just as certain that had the owner of the ten acre tract above mentioned put upon the ground the one hundred and eighty-five twenty-four hour inches that went to the sea the other one hundred and eighty would have done more duty than they did. The one hundred and eighty-five would have covered the tract about nine inches deep, which would in effect have been equal to about eighteen inches of rain as it generally comes here in winter. Added to the regular rainfall, which at that place is about twenty inches, it would have put the ground in such condition that almost anything but oranges, lemons, berries and a few such things would give a good yield without any irrigation in summer. When water becomes valuable enough to make people store it in the ground if they cannot afford to store it above, the duty of water will be estimated by the depth of water put upon the tract during the year. Until then it will be estimated by the rate for the irrigating season because the great majority of the canals of the country depend upon the flow of streams that are lower during that time.

If "the season" were everywhere the same we might compute in this way. But as it varies continually with locality and products you will never unravel the tangle of opinions on the duty of water until you understand the following figures:

A miner's inch under four-inch pressure will cover about fourteen and a quarter

acres one foot deep in a year. Now if we call "the irrigating season" two hundred days, then the number of acres to an inch of water will by this mode of counting be two hundred three hundred and sixty-fifths of fourteen and a quarter ($\frac{200}{365}$ of $14\frac{1}{4}$). This will be about eight. But counting by the year the number of acres watered to the same depth would be about fourteen and a quarter. So they will call an acre foot if used in two hundred days an inch to eight acres, but if used all the year an inch to fourteen and a quarter. Two acre feet would then be an inch to four acres by the season, but estimating the other way they would be three hundred and sixty-five two hundredths to four acres ($\frac{365}{200}$ of 4) which equal about seven. And in the same manner four acre feet would be an inch to two acres by the season and about three and a half by the year.

The only reliable way to find the amount of water used is to take a tract of known area and watch it while being irrigated so as to get the percentage wasted at the lower end. This will vary greatly, some wasting even more than half the head while others will have the lower end of the tract thoroughly wet without wasting one per cent. As this waste can be found only by guess considerable care must be used in comparing it with the head at the upper end. As the owner knows little more about what he is putting on than the most intelligent Hottentot knows about the rainfall that produces his banana crop, you had better go to the office of the company and ask to see the water account of that tract. If you satisfy the officers that you are seeking information for a proper purpose and will not use it in any other way, you will seldom be refused a full inspection of the books. Sometimes it may cost you the drinks and some cultivation of the secretary or ditch-tender until he finds you are a harmless person.

Get the number of twenty-four hour inches delivered to that tract during the

irrigating season and also during the year. Deducting the unnecessary waste you can then reach the duty of water by both methods. As a rule you will find the duty of water much greater than the owner himself would give it to you. But you will find that some people, with exactly the same amount of land, same soil, crops, and all conditions, have ordered and paid for twice as much as their neighbors. By watching these tracts you will find this difference due mainly to waste. But in some it is due to using water more often and letting it run longer. There are individual differences due often to the whim of the irrigator and often to the desire to experiment that cast much uncertainty on the conclusions drawn even from the best data.

For alfalfa it is certainly safe to err in using too much water than too little. So with oranges and lemons, melons and many other things. There is little danger of using too much water for corn, but you can easily use so much as to make the yield of grain lighter instead of heavier. Grapes to be used for wine, olives and peaches and other fruits to be shipped some distance to market will not be apt to suffer if the error is on the side of too little water. It would almost take a treatise on agriculture and horticulture to go through the list of all products in this way, but the difference should be kept in mind.

The waste above referred to means direct waste. Indirect waste is a great item that reduces the duty of water. The commonest form of this is using water instead of the cultivator, already sufficiently explained. It is a great absurdity to charge against the duty of water the amount poured on by one who will persist in irrigating in the old Indian style. Yet under many ditches fully one-half the water is still wasted in that way. And the resources of that section are depreciated by charging it against the duty of water.



FOURTH ANNUAL SESSION OF THE KANSAS IRRIGATION CONGRESS.

BY L. BALDWIN.

THIS organization convened at Great Bend, Kansas, according to previous announcement, and held one of the most important meetings in the history of the irrigation movement. The attendance and interest increased from the reading of the call on Thursday morning until late Saturday evening, three sessions each day. We had material for another day's discussion, but as Sunday was approaching we had to adjourn. The papers read and the subjects discussed indicated a high degree of intelligence upon the great subject of the reclamation of the semi-arid lands of Kansas. Good critics say our program contained more attractive and pertinent matter than was ever before presented. The three members of the Kansas Irrigation Board were present and explained the progress they were making in solving the problems contemplated by the act of the Legislature; the State University furnished Chancellor F. H. Snow, who lectured on the method of getting rid of grasshoppers and other insects that damage irrigated crops. The hints he gave to that end are valuable to our farmers and gardeners; Prof. Haworth lectured upon the artesian waters of Kansas, and located the places where we might find flowing wells and where it is useless to explore; President Fairchild and Prof. O. P. Hood, from the State Agricultural College, discussed their subjects in a very instructive way.

Two experts were with us from the United States Geological Survey—Willard Johnson and W. G. Russell, who lectured upon the underground and surface waters of western Kansas. The secretary of the State Board of Agriculture was here to tell us about "*some other things*." Hon. John E. Frost, land commissioner of the Santa Fé road, read a paper on the "Progress of Irrigation in the Arkansas Valley." W. C. Edwards read a paper on "A Little Farm Well Tilled." Judge J. S. Emery was in his element while exhorting the people living upon the great plains to "stay right where they are," as they were

sure to have plenty of neighbors in the near future. He quoted Hon. Tom Reed as saying that "beyond the Mississippi river is the country where will be found the wealth and greatness of the days to come." He quoted an editorial from the Chicago Tribune which read: "Kansas can boast of a greater diffusion of popular education and a smaller percent. of illiteracy and crime than any other community on the face of the globe, and for all that pertains to a strong and vigorous state the history of civil society furnishes no parallel."

George Munger, of Eureka, Kansas, told us about his big artificial lake of ninety acres, which he had created by damming a large drain, and which he was using to irrigate an orchard of 600 acres of trees. He raised cabbage to such an extent that he stopped the importation of it into his county. The limits of this magazine will not permit me to keep on, as I have started out, to review all the articles and papers by all the gentlemen on the program, so I will refer them to my official report, and also to the Kansas Farmer, in which the papers read will appear from time to time. The following resolutions were adopted:

Resolved, First, That we appreciate the work of the State Irrigation Board and know it has done all and only just such work as it could do under the provisions of the law creating it, and now think its power or the powers of some other authority or commission should be greatly increased by the next legislature so as to enable it to meet all the wants and needs of our people in carrying forward the great work of reclaiming our semi-arid lands.

Resolved, Second, That Kansas most earnestly asks the General Government to create an *Irrigation and Forestry Commission* for the examination, utilization and conservation of the water supplies and forest growths of arid and semi arid America.

Resolved, Third, That we fully appreciate the work done in Kansas by the

United States Geological Survey under the immediate direction of F. H. Newell in the gauging and measuring of the river waters of this State, and we urge that this work be carried forward to its full and final completion at as early a date as may be practical.

Resolved, Fourth, That we extend our most hearty thanks to the citizens of Great Bend for the many courtesies we have received at their hands, and also to those gentlemen who have addressed this convention and also to the *press* for giving us a hearing before the general public.

Signed:

DR. BOHRER,
W. ANDERSON,
J. S. EMERY,
M. B. TOMBLIN,
W. C. EDWARDS,
D. M. FROST,

Committee on Resolutions.

The following gentlemen were chosen as officers and executive committee for the next year:

President—I. L. Diesem, Garden City, Kan.

Secretary—L. Baldwin, Great Bend, Kan.

Treasurer—Geo. M. Munger, Eureka, Kan.

EXECUTIVE COMMITTEE.

Hon. John E. Frost, *Chairman*, Topeka, Kansas.

E. R. Moses, Great Bend, Kansas.

Judge W. B. Sutton, Russell, Kansas.

Prof. E. Haworth, Lawrence, Kansas.

D. M. Frost, Garden City, Kansas.

I. L. Diesem (*ex-officio*).

L. Baldwin (*ex-officio*).

Geo. M. Munger (*ex-officio*).

The Chancellor of the State University of Kansas having extended a hearty invitation to the Irrigation Congress to meet in Lawrence next year it was accepted by a rising vote, the time to be determined by the executive committee. The Congress then adjourned.

L. BALDWIN, Secretary.

Great Bend, Kansas.

October, 1896.



FULL BLOODED CATTLE ON A NEBRASKA RANCH. COURTESY OF THE CORN BELT.

SOME RECENT COURT DECISIONS.

ADVERSE POSSESSION—ABANDONMENT.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN the case of Smith et al vs. Hope Mining Company, the Supreme Court of Montana held that the defendant's use was not adverse to plaintiffs' right, where in a compromise settlement as to water rights between two mining companies it was agreed that the defendant had prior rights to fifteen inches of water, and that it should take the same through plaintiffs' ditch, and that it should also have the use of a further amount of water which was over and above the water necessary for plaintiffs' mill. The evidence disclosed the fact that plaintiffs closed their mill in 1883, and from that time to 1893 used no water; defendant, as it might under the contract, during this period, using all the water conveyed into the ditch. Also the defendant gave no notice by word or deed that it claimed otherwise than under the contract.

And also in the same case, when plaintiffs' mill was shut down, a man was employed to drain all the pipes and oil the machinery, and during the whole period of non-use some one had charge of the property, a watchman being on the premises and caring for them most of the time. The water was not used simply because the machinery of the mill was not in motion. The court held that there was no intention to abandon the mill, and hence none to abandon the appurtenant water right.

CORPORATIONS.

In the case of the Consolidated Canal Company vs. Peters, decided by the Supreme Court of Arizona, 46 Pac. Rep., 74, it was held that a contract between a canal company and the shareholders in an unin-

corporated joint stock association, whereby the former party of the first part agrees to furnish water to the "respective parties" of the second part, and the latter agrees to rent their "respective" shares in the association to said first party in a several contract, and either of the second parties may maintain suit for damages occurring to him thereunder, without joining the others.

Also in the same case, where the Utah Canal Company rented their shares to defendant, a corporation, the latter agreeing to deliver water to said parties "at and on the basis rate of not less than three shares for the necessities of a quarter section, said water being in the river. * * * It being understood that, in case of low water, defendant is to deliver that amount of water that the Utah canal could or would deliver if they were in full control." A complaint by one of the shareholders who entered into said contract alleged that defendant refused to deliver water in sufficient quantities to irrigate the crops when there was water flowing in the river sufficient for such purpose, and, at periods of low water, had refused to deliver to plaintiff the amount of water that the Utah Canal Company would or could deliver if it were in control. However, the complaint did not allege that plaintiff ever requested defendant to deliver water to him, and did not state how much was necessary nor the the quantity actually delivered, and there was no averment as to the amount that could or would have been furnished by the Utah Canal Company. The court held that the complaint did not state a cause of action.



AFTER THE CONGRESS.

THE natural resources of the wonderful State of California and its unrivalled climate have been written about innumerable times, nevertheless, it will not be out of place to refer to them again at this time, as the delegates and visitors at the Fifth National Irrigation Congress at Phoenix, Arizona, December 15 to 17, will have an opportunity of personally inspecting some of the more renowned points, especially in southern California. After the close of the congress excursions will be made to Los Angeles, Riverside, Redlands and several other towns for the purpose of showing what can be accomplished with a combination of California climate, fertile soil and water.

The model colonies will undoubtedly attract the most attention from those who are in any way interested in the movement of population from cities to country homes and its relation to irrigation, and also its relation to the welfare of the nation at large. The community settlements in California have been a success, though possibly not as great a success as their founders hoped for, but they clearly demonstrate that the associative principle will underlie all future development in reclaiming the arid lands of the West.

Colonization and irrigation go hand in hand. Nearly, or indeed, every effort to establish a dry-land colony in California has ended in failure. Probably the earliest notable experiment in the colony line was in 1857, at the time the first grape craze swept over the state. Some German mechanics in San Francisco were infected with the vineyard fever, and not one of them could bear the expense or had the necessary experience to plant and bring to maturity a twenty-acre vineyard. After considerable discussion they decided upon what was then an original plan, and which may be said to be the pattern for modern colonies. One of their members was delegated to visit southern California, investigate and report. A tract of 1,200 acres

was contracted for at about \$1.50 an acre, a superintendent chosen, and under his directions the tract was laid out, a town site surveyed and the whole area planted with trees and vines in such manner that when the colonists took possession of their property, each twenty acres should have the same area of the different varieties of fruit. The members of the colony remained at work in San Francisco until the vines began to bear fruit, and then moved on their little farms, which were now self-sustaining.

Such in brief is the history of the Anaheim colony, which will probably be one of the points visited by the irrigation congress delegates.

The success of Anaheim was followed by the founding of other colonies, some of which have become known the world over.

The casual visitor or tourist who is unacquainted with the miracles irrigation has wrought will be inclined to think that he is being given a modern version of Andersen's fairy tales instead of every day truth. It may stretch his belief in the veracity of the narrator beyond the limit when he is told that this superb state produces annually 70,000,000 pounds of raisins, 30,000,000 pounds of prunes, 8,000 carloads of oranges, 20,000,000 gallons of wine, 26,000,000 pounds of beet sugar, not to mention the other fruit, vegetable and cereal crops. And all of these products dependent, in a large measure, upon artificial watering to bring them to maturity.

But if the visitor is not interested in such practical matters he will be amply repaid for the trip by the sights and scenes along the way, or he can join one of the excursions which will visit the Grand Cañon of the Colorado, where he will find some of the grandest and most imposing scenery in the world.

For further particulars regarding the congress and the excursions to follow it, see the announcements elsewhere in this issue.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, cornercubs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

HOW BARNYARD MANURE IMPROVES THE SOIL.

BY F. C. BARKER, OF NEW MEXICO.

A LITTLE knowledge is a dangerous thing. This maxim is particularly to be borne in mind when one comes to apply chemistry to the science of farming. A very good instance of this occurs in the study of the land in the Rio Grande valley. This land is yearly irrigated by the waters of the Rio Grande river, which contain an abundance of potash, phosphates and nitrogen—indeed far more of these fertilizers than are removed by the yearly crops. Let us take, as an example, the nitrogen, the most essential item in plant growth. The land receives an average of at least 24 inches of water from the river every year, and the sediment of this water leaves 107 pounds of nitrogen on each acre. An acre of wheat does not remove more than 45 pounds of this nitrogen. It therefore follows that if the land is irrigated and cropped with wheat year after year, as is often the case, the land will in time be so full of nitrogen that there will be no deficiency of this fertilizing item whatever be the crop that the farmer wishes to raise. As for potash and phosphates the excess will be still greater. But this theory does not work out in practice. Actual experience has shown that this land will not raise cabbage, or other garden truck, without the application of barnyard manure, and that even the wheat crop will be nearly doubled by putting on say 10 tons of this manure every three or four years. Now it is evidently not the nitrogen in the manure that thus benefits the crop, for ten tons of manure only contains about as much nitrogen as the 24 inches of water; moreover, there is already an excess of nitrogen in the soil.

HOW NITROGEN IS UTILIZED.

The explanation is to be found in the fact that the nitrogen deposited by the water is in an inert state, and not capable of being utilized by plant life. Before nitrogen can be absorbed by plants it must go through a ferment. The most modern chemical researches have shown that this ferment is caused by minute living organisms or bacteria of a somewhat similar nature to those which cause the fermentation of wine, cream, etc. These organisms are found in abundance in humus (decayed vegetable matter) and barnyard manure. Now it is well known that our western land in the arid districts are particularly deficient in humus and unless these fermenting organisms are applied to the land by means of barnyard manure the nitrogen already contained in the soil is apt to remain in an inert state, unfit for plant food. The experience of farmers, not only here, but in many parts of the world, is that barnyard manure gives results far in excess of what might be expected from its actual fertilizing contents. The reason of this is that the fermenting organisms contained in the manure not only render the nitrogen in the manure fit for plant food, but they ferment and convert into plant food the inert nitrogen which already existed in the soil.

There is, of course, an additional reason why barnyard manure is beneficial, and that is that it improves the mechanical condition of the soil and the humus enables it to better hold moisture.

It therefore follows that however rich land may be considered to be if it is deficient in humus a light dressing of barnyard manure every three or four years will probably be found to yield beneficial results far in excess of the cost of supplying the manure.

PLANT FOOD RESERVOIRS.

BY E. MIALl SKEATS IN THE PECOS ARGUS.

“WHAT an expanse of useless land,” if often the remark and still oftener the thought of people traversing our foot hills. As well might they say “what an expanse of useless water” when they view our huge storage reservoirs.

The foot hills are reservoirs of soil for our valley lands. Immense amounts of plant food are stored there and are being manufactured into available forms every year, and as they are manufactured are distributed over the valley.

Visit the hill now after the heavy rains we have just experienced. Besides the conspicuous Cacti, Yucca, Euphorbia, you will be surprised at the number of small—some exceedingly small—annual and perennial plants covering the rocky ground. Choose almost any of these and try and pull it up by the roots. It resists. Lift up the flat stone adjoining and you find the roots underneath ramifying sometimes for several feet in as fine a vegetable mould as any gardener would wish to see.

But see! There is actually an earth-worm in it, right on top of the hill. And how wet the soil is, though down in the valley at the same depth it has become fairly dry.

You have surprised some of nature's agents in full work in a veritable chemical laboratory by lifting that stone. The radiated heat from the flat stone fully exposed above to the sun's rays has warmed up the damp thin stratum of vegetable soil, and given extreme impetus to the root play of the plants in the crevices, the evaporation from whose leaves is about the only exit for the remaining moisture in the soil.

But this warmth has so enlivened myriads of microbes which are rejoicing in the feast of dead vegetable matter in the soil, and their growth results in further decomposition of the dead rootlets, and the evolution of carbonic acid and other gases.

These gases, imprisoned under the slab, attack the stone itself, till by very imperceptible degrees, it crumbles away and adds its valuable ingredients to the vegetable soil. Nitrates in abundance are formed in this damp, warm compound. Phosphoric acid, rich in the stone, is made

available, or partly so, for plant use, and so are the lime and magnesia.

The earth worm does his share; he devours the dead rootlets and leaves and swallows small particles of stone not decomposed. He uses the stones as masticators and wears them down till his strong digestive fluids dissolve much of them with the vegetable matter and what he does not want for his own economy he leaves for future generations of plants.

By the time the next rains come there is a store of the richest plant foods in soluble form under this stone. The first floods wash this out and carry it to the nearest gully. It flows down this onto the plains, where it is dispersed, and much is caught and held by the heavier, more clayey soil. In the spring, with the strong west winds, much of this is still further distributed over the valley and farms.

Who can say that the foot hills are of no use to us?

FOREIGN MARKETS.

In his annual report Secretary Morton says during the fiscal year just ended the exported products of American farms aggregated \$570,000,000, an increase of \$17,000,000 over the preceding year. In spite of this there was a falling off in the percentage of agricultural products exported to the total exports, but this was due to the unprecedented sale abroad of American manufactured goods. The principal market for American products is found in the United Kingdom of Great Britain and her colonies. These English-speaking people bought 58 per cent of all exports from the United States in the fiscal year 1896. Together with Germany, France, Holland, and Belgium, they purchased 81.9 per cent of our entire output, leaving 18.1 per cent for the rest of the world.

The total consumption of meat in Great Britain for the year was 1,100,000 tons, 75 per cent of which was produced at home, the remaining 25 per cent being imported. Of live meat arrived in the United Kingdom during the first six months of 1896 the United States supplied 75.10 per cent of the cattle and 45.26 per cent of the sheep. The Glasgow market is especially recommended to American shippers, as in that city cattle

from the United States compete with the very highest quality of British animals.

American packers, the Secretary says, are not participating in the profits of the growth in consumption of swine flesh and hog products in Great Britain as much as they ought to, because they do not cure meats to suit the British demand. On the other hand, Danish and Canadian packers are increasing their shipments every year. American bacon averages about two cents per pound below continental and Irish bacon, and about three cents below English.

The shipment of American horses to England is steadily increasing. In 1893 Great Britain took 13,737 American horses, nearly 23,000 in 1894, and 34,000 in 1895, but during the first nine months of 1896 more American horses were shipped into England than in any previous twelve months.

Kaffir Corn.—J. H. Shaeffer called last Saturday at our office and gave us an account of his crop of Kaffir corn, says the Lake Charles (La.) American. He planted the corn on new ground that had never been fertilized, and put no fertilizer on the crop. He says the yield was five wagon loads of heads per acre, that would shell out fifty bushels of clean corn. Since cutting the first crop, the corn has continued to grow and has put forth new heads on which the grain is now forming. Mr. Shaeffer says the Kaffir corn will continue to grow until frost. In view of the above facts, given by one of the most careful farmers of this region, we claim that Kaffir corn is the best food crop to grow in this region.

The points in its favor are, first, that it grows luxuriantly and yields well on new and unfertilized ground; second, that it will stand a drought better than almost any other crop—equaling sugar cane and sorghum in this respect; third, that it will give a large yield of grain—amounting from forty to sixty bushels per acre, the first crop, and will then produce a second crop of grain, and an enormous yield of fodder for a second crop; fourth, that the grain is excellent, fully equaling in value the common corn for stock feed, and producing, when ground, meal or flour much superior to the common corn. It is said that flour made from Kaffir corn is fully

equal to buckwheat flour for griddle cakes, and makes a delicious bread when baked.

The drawbacks are few, the principal one being that birds are very fond of it; and when only small patches are planted they destroy it badly. When this corn is planted largely, as it should be by our farmers, this objection will cease.

General Purposes.—When searching for an all-purpose animal, whether it be cow, sheep or hen, just remember that no animal can use its food twice. If a cow converts her food into milk she cannot convert the same food into beef. If a sheep converts his food into wool he cannot convert the same into mutton. If a duck converts its food into feathers, it cannot convert the same food into eggs; hence, if you pick your ducks and geese regularly, you need not expect many eggs from them. Of course every animal gets a living from what it eats—enough to sustain its life and strength—before it turns off any surplus for you. But if it has been bred to turn the surplus into beef, you will lose money trying to persuade it to yield butter instead. Decide what kind of a surplus you want, and get the breed which converts its food into that product, and don't expect one mill to turn out graham flour and horseshoe nails.—*Texas Stock and Farm Journal.*

In Egypt at least 50,000 pumps and water-wheels are in use. The power used for propelling these consists of wind and oxen. About 200,000 oxen are used for pumping water from wells which are shallow and dug after a very crude manner. The water thus secured is used for irrigating rice and cotton. The average cost of well and pump is about \$150 and the cash rental of land ranges from \$2 to \$5 an acre. This method though crude, enables the farmers of Egypt to secure good returns.

Massachusetts has the largest cider mills in the world, using 8,000 bushels of apples per day and producing 32,000 gallons of refined cider daily. Our readers who are not in the apple belt will readily see the profit in the fruit for the growers get from six to nine cents per bushel. This factory exports over one and a quarter million of gallons to England annually.

The Irrigation Farmer.—Irrigated farms have a tendency to induce their owners to cultivate crops that will pay the largest profits, and the irrigation farmer is in a vast majority of cases, a man of high intelligence who studies to make his land as profitable as possible. He has broken loose from the traditions of his forefathers because he is surrounded by different conditions.

Save the Winter Rains and Snows.

—The winter rains and snows are a constant source of waste of water that might be held in natural basins or easily constructed reservoirs for use in irrigating during the coming season. There is no better time than the present for irrigators to investigate the subject of securing an independent water supply.

If the soil is of a character to admit of constructing catchment reservoirs every available location should be used. In the foothills of the mountain valleys are basements covering from one to fifty acres where with a little work a large body of winter water may be held. Small channels made with an ordinary plow will be sufficient to lead the water into the reservoirs. In this manner the rains that would otherwise swell the mountain streams and run away causing frequent floods and damage can be utilized to furnish moisture for the next season.

The Government Seedshop.—By order of congress \$130,000 worth of seeds will be distributed in 1897. This equals \$288.89 for each representative, senator and delegate in congress, or enough to allow 30,000 packets of seeds to each member, including field seeds in quart packets. In buying this seed bids were invited from all firms, and to insure seed adapted to the various sections the contracts were awarded to a responsible firm in each section—eastern, south Atlantic, middle western, northwestern and southwestern states, contracts for the Pacific states not yet being awarded.

Selling to Consumers.—A writer in Detroit Tribune says that when in England last winter, he noticed the farmers were trying to cut the middleman and deal directly with the consumer. One method was to advertise freely in the newspapers.

An advertisement read thus: "Provisions from a Suffolk farm—Twelve new laid eggs, one pound of butter (silver medal), jar of cream, two plump fowls—or one fowl and a loin of pork, one pound of sausages, jar of potted meat; carriage paid, London or suburbs, cash on delivery, 10s. 9d. M. Suffolk." Another was as follows: "Welsh mutton, direct from the farmer, 8½d. for the whole, sheep averaging 40 pounds, delivered free to any address in London. Send postal order 30s.; balance, if any, returned in stamps—Reference. etc." Why cannot the idea be carried out in this country? Possibly it is in some places, and if any of our readers know about it we shall be glad to hear with what success it is attended.

Carrying Stock.—A stock run from Pueblo to Kansas City, a distance of 635 miles, was made in twenty-one hours and twenty-seven minutes, on the Atchison recently. No other line has as yet come within that limit of speed between these points, in hauling a stock train of similar tonnage,—that is a speed of thirty miles an hour including all stops and delays in transit. Such time is possible because there is a system and discipline built up on the Atchison that is as near perfect as may be. The humblest employee as well as the highest official, seems to be at all times enlivened with a sense of importance in maintaining a routine that carries with it safety and dispatch.

Some of the soils in the irrigated districts which were formerly hard and difficult to work have changed and become mellow. The water has undoubtedly caused a chemical and mechanical decomposition of the components of the soil which has caused it to continually improve. Even certain kinds of hard-pan have been known to dissolve when irrigated.

A farmer sent a dollar for a lightning potato bug killer which he saw advertised in a paper and received by return mail two blocks of wood with directions printed as follows: "Take this block No. 1 in the right hand, place the bug on Block No. 2 and press them together. Remove the bug and proceed as before."

A patch of sweet corn makes one of the best crops to grow to commence feeding hogs intended for fall market.

The Pecos Valley of New Mexico.

The part of the Pecos Valley which The Pecos Irrigation and Improvement Company has undertaken to reclaim by irrigation, is situated in southeastern New Mexico, extending into northwestern Texas, and comprises a large area of as highly productive agricultural and horticultural land as can be found on the American continent. At intervals along the Pecos River, for a distance of 165 miles, have been constructed dams, reservoirs and canals, furnishing an abundant and unfailing supply of water for 400,000 acres, over one-half of which area is already covered by the canals. The reservoirs have a total capacity of 6,300,000,000 cubic feet of water; the canals, with the main and sublaterals, have a total length of 1,500 miles. About 75,000 acres are already in the hands of settlers, of which over 25,000 acres are in actual cultivation, 2,500 acres being in orchards and vineyards. To further develop this region, a standard gauge railway, 164 miles long, has been built through the entire length of the Valley. Towns and villages have been started, of which Eddy and Roswell are the largest, the former having about 2,500, and the latter about 2,000 inhabitants. Hagerman, Otis, Florence, Francis and Malaga are also growing villages. This work was undertaken a little over seven years ago, and has already cost over four millions of dollars. The Pecos Valley now ranks as the largest irrigation enterprise in America, and one of the largest in the world.



A THREE-YEAR-OLD APPLE TREE IN THE PECOS VALLEY.

Soil, Climate and Productions.

The soil of the Pecos Valley is, in the main, a sandy loam, and is of remarkable depth and richness. The climate is warm and sunny, practically winterless, with long growing seasons, and likewise possesses wonderful health-giving and health-restoring properties, especially for pulmonary and many other chronic diseases. This soil and climate, with the abundant water supply, unite to produce bountiful crops of all the grains, grasses, berries, vegetables and fruits of the temperate zone. Such forage crops as alfalfa, sorghum, Indian and Egyptian corn grow most luxuriantly, making the feeding of cattle, sheep and hogs a most profitable industry. The sugar beet attains a perfection not reached elsewhere in the

United States, if in the world. A beet sugar factory, with a daily capacity of 225 tons of beets, is now being built at Eddy, and will be in operation November 1, 1896. To supply this factory the farmers of the Valley are now putting in fully 2,500 acres of beets, for which the sugar factory has contracted to pay \$4 per ton delivered at any station on the Pecos Valley Railway, the company paying the freight to the factory. At this price, and with the large yield per acre in the Pecos Valley, the farmer should clear all the way from \$35 to \$75 per acre from his crop of beets.

In the raising of fruits the Pecos Valley will take its place among the most highly favored sections of our land. All the standard fruits of the temperate

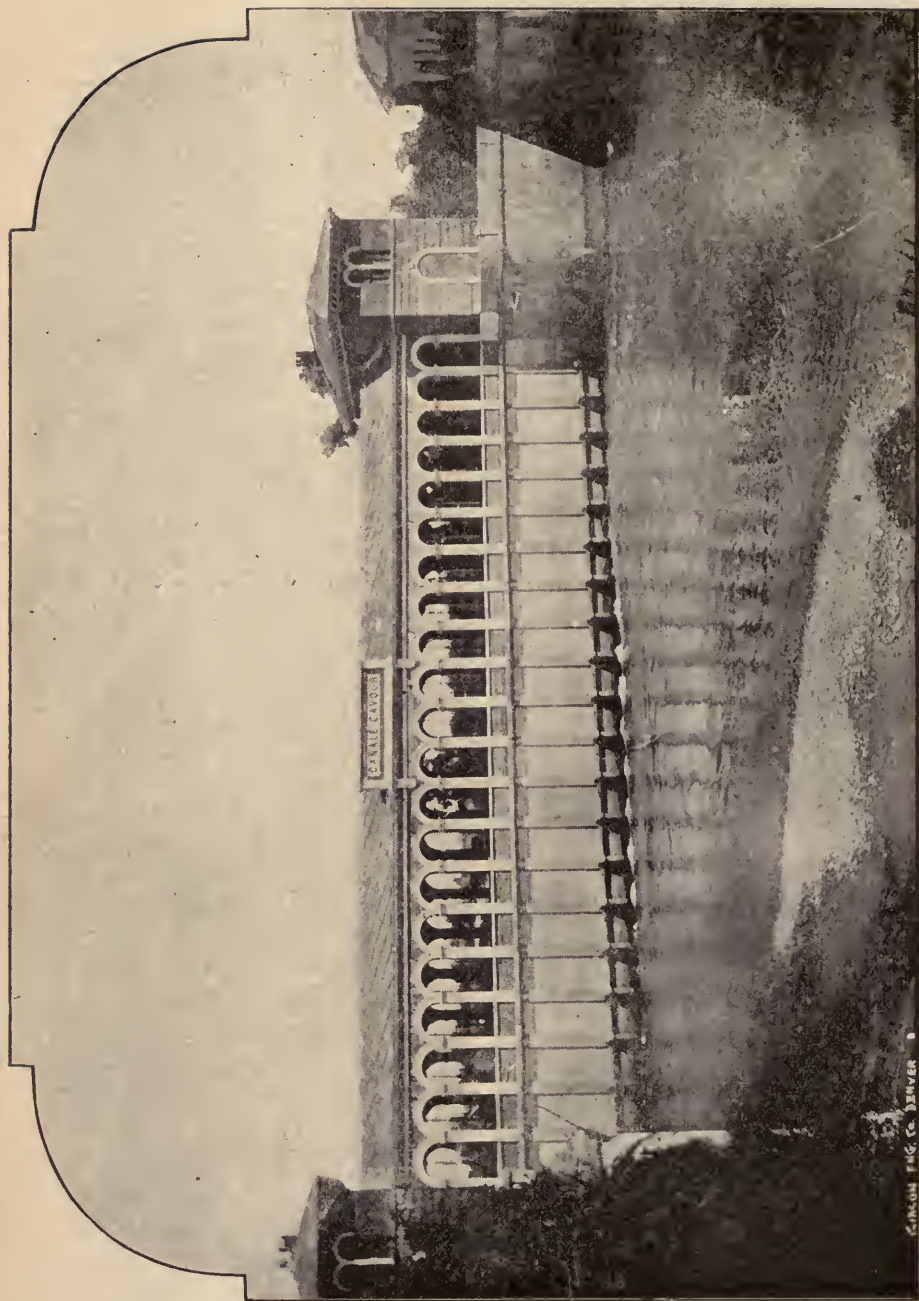
zone are successfully raised, while several of these attain a perfection rarely equaled and nowhere surpassed. At the head stand the apple and pear, closely followed by the peach, grape, nectarine, apricot, plum, prune and quince. All the small fruits grow in abundance. The fruits of the Pecos Valley are without blemish, superb in form and coloring, and of unequaled flavor. In a few years they will be found in all the great markets of the country, commanding topmost prices because of their beauty and perfection.

Social and Educational.

The Pecos Valley is being settled in the main by progressive and intelligent people, the majority being Americans, mainly from the Central West. As a result, schools and churches are found in every town and village in the Valley.

The Pecos Valley, while attracting the general farmer and fruit-grower, holds especial attractions for those whose health requires an outdoor life in the dry, elevated region of the Rocky Mountain plateau; and these will there find not only the health they seek, but profitable occupation as well. Not only does this life appeal to the health-seeker, but also to the thousands all over our land, and especially in our large cities, who wish to exchange the life of grind and drudgery and narrowing industrial conditions, for one of independence and a larger hope for the future.

For prices of land, and terms, with copies of illustrated publications, address The Pecos Irrigation & Improvement Co., Eddy, New Mexico.



CAVOUR CANAL IN ITALY (Irrigation),

KARON ENG. CO. DENVER

THE IRRIGATION AGE.

VOL. X.

CHICAGO, DECEMBER, 1896.

NO. 6.

THE PROGRESS OF WESTERN AMERICA.

Again the Homeseekers Association. The work of The Homeseekers Association has progressed rapidly during the past month and its membership is increasing to thousands. It seems to have struck a popular chord and everywhere meets with great encouragement. The large percentage of population which is considering a change of location in the expectation of finding better conditions is almost inconceivable to the average mind. As an illustration of this it may be cited that the simple announcement of a meeting invariably caused the headquarters of the Association to be filled full to overflowing with those seeking information. The most prominent feature of this month's work was the public meetings both in Chicago and Minneapolis. At the meetings in Chicago were delivered lectures on the resources of some of the Western and Southern States. The Minneapolis meeting was called at the instance of the Board of Trade and Mr. Girling was invited to address it on the Association and its work. The direct result of this meeting was the organization of a branch association.

On Sunday, January 3, a special Homeseekers service will be held in the Militant church and the pastor, Rev. Dr. John Rusk, and Mr. Girling will speak on the subject of "Homes for the People." This service in one of the best known churches in Chicago on the first Sunday in the new year, will mark an era in the development of practical work in behalf of those who are trying to secure homes and become self sustaining and independent.

Industrial Colonies may be Organized.

The great interest that has been aroused has been shown by the large attendance at the weekly meet-

ings, and by the hundreds of letters showered upon the secretary from persons scattered over the country from Florida to Washington, and particularly by the numerous requests that the Association shall organize a "model industrial colony." This matter has not been definitely settled although it is under consideration, and the Association may decide that it can best serve those it is seeking to benefit by undertaking as a part of its public work, the supervision and organization of a series of small colonies. These colonies if undertaken will be used to demonstrate the practicability of transplanting the average city resident, professional man, merchant or mechanic, to country homes, and under what conditions he will be most successful. The details of the plan have been submitted to people well informed in matters of emigration and have been declared perfectly feasible, and in fact in advance of anything thus far presented to the public. These colonies will be conducted upon a basis of actual cost with a small allowance for unforeseen contingencies. This will be an excellent opportunity for the friends of irrigation and the West to place before the Association their claims to one or more of the colonies.

The Irrigation Congress. The Fifth National Irrigation Congress has come and gone. It entered upon its duties at Phoenix, Arizona, December 15, and adjourned December 17, 1896. Its principal work was the location of the next congress at Lincoln, Nebraska, where an opportunity will be given of showing what the semi-arid region has been doing in the matter of irrigation. The attendance was as large as could have been expected, and the interest manifested was equal to that

shown at the Albuquerque congress a year ago. The date coming so near the Christmas holidays prevented some people from going who might otherwise have attended, and, as was stated in these columns in September, the lack of meetings throughout the Northwest during the summer, resulted in an exceedingly poor representation from that section of country, although the few delegates who were present ably acquitted themselves, and in a measure compensated for their scarcity in number. Another regrettable fact was the meager reports which appeared in the newspapers, not as much space and attention being given the congress as was devoted to a convention of Sunday-school workers in Boston recently, and, without in any sense meaning to belittle the Sunday-school convention, its importance cannot be compared with that of irrigation; the reclamation of the Great West; the making of homes for millions of contented and industrious people; the creation of new industries and the founding of a new civilization under better and nobler conditions for the average man. In order to interest the general public, and especially the Eastern editor who usually looks with suspicion on all matters of Western origin, it is necessary to organize a propaganda and carry on an active warfare with public meetings, such as the irrigation mass meetings which were held in New York, Boston and Chicago, in the spring of 1895; and to bring to bear every possible influence to show that irrigation is a living, breathing *National* issue, not merely a local matter pertaining to Utah or Arizona.

What It Aimed At. The Irrigation Congress of 1896 will go down into history as the congress that tried to do something. It was purposed to formulate a definite and settled policy regarding the public domain, the reclamation of arid lands, the conservation of the water supply, and to present and pass judgment upon bills regulating the settlement and use thereof; to recommend some settlement of the disputes regarding international streams; to recommend such legislation as was necessary in each of the seventeen arid states and territories to secure the wise control and use of water for irrigation; to deal with the preservation of the forests, and the reservation by the Federal government of reservoir sites and

the construction of dams thereon; to organize a lobby to visit Washington and influence legislation in favor of western interests, and to provide a fund for the expense of such a committee. It was intended to confine the Fifth Congress strictly to business and not to running off on excursions, and wasting time on public dinners and speeches; it was expected that it would be more largely attended than any of its predecessors because of the growing interest in the subject and also because of the reputation for integrity and ability that characterized some of the leaders of the movement. The expectations of the public were, it is said, raised to fever heat and the convening of the congress watched for with many anticipations of the great good it had an opportunity of doing in behalf of arid America; it was also purposed to more closely cement the friends of irrigation into an association which would have rules, and regulations and a membership fee. This last purpose was accomplished. An association was organized with 103 members each one of whom paid the fee of \$1.00.

Some Practical Results. Some of the papers presented before the congress were prepared by men of more than ordinary ability. They are confined to problems that are of the utmost importance to the development of the West. They treat of practical questions in a practical way and they should be carefully studied by those who were not so fortunate as to be present at their reading. A couple of them appear in this issue of *THE AGE*, entitled "Immigration into the Arid Regions," by John E. Frost, Land Commissioner of the Santa Fe; and "Irrigation in the Eastern States," by F. H. Newell of the Geological Survey. Several more of the most important addresses will appear in early issues of *THE AGE* and altogether they constitute the greatest practical benefit derived from the recent congress.

The New National Committee. The congress elected the following named to be officers for the ensuing year: Chairman of the executive committee, E. R. Moses of Great Bend, Kan., re-elected; Vice-Chairmen, Brigham Young of Utah, and E. G. Hudson of Illinois; treasurer

A VALLEY IN SOUTHERN CALIFORNIA.





ELWOOD MEAD,
State Engineer of Wyoming: Cheyenne.

M. G. Utley of Rhode Island; national lecturers, J. Emery of Kansas and I. A. Fort of Nebraska.

The national committee chosen embraces: Arizona, James McClintock; California, J. D. Schuyler; Colorado, L. Kellogg; Connecticut, J. B. Abbott; Idaho, F. J. Mills; Illinois, Dr. Clarke Gapen; Iowa, Professor J. D. Budd; Kansas, J. H. Churchill; Maryland, G. W. Garrett; Montana, S. M. Emery; Missouri, H. C. Weber; Michigan, Fred B. Spread; Minnesota, T. M. Frost; Nebraska, A. G. Wolfenbarger; New Mexico, C. P. Fancher; New York, Dix W. Smith; Nevada, L. H. Taylor; North Dakota, W. W. Barrett; Oklahoma, Professor Henry E. Glazier; Ohio, B. F. Shuart; Pennsylvania, George W. Alpert; Rhode Island, M. G. Utley; Texas, W. S. Marshall; Utah, L. W. Shurtliff; Washington, L. S. Howlett; Wisconsin, J. E. Godding; District of Columbia, Judge Emery F. Best.

Land and Water. The question of right and title to land, and the necessary water for the irrigation thereof, is of the utmost importance in all our Western States. It is a question which has been discussed many times, but no adequate solution has yet been found, at least none

has been crystallized into a law and placed upon the statute books, either of the various States or the Nation at large. This condition cannot exist forever; it is working a grave injustice to those already settled on arid land, and to those who are crowded into the large cities unable to find employment and support for themselves and families, while the public domain, rich to bursting of nature's wealth, is lying unoccupied and unused. As long as the title to public land remains in the Federal government and the right to sanction the use of water in the various State governments, this vast heritage of the people will remain unoccupied. This question has been solved and re-solved by those laboring for the public good, as well as those with an eye single to a personal interest; it has been strained through a sieve, which like the grist from the mills of the gods is "exceeding fine," but no general solution of the anomaly of two distinct organizations controlling nature's resources, land and water, the combination of which is so absolutely essential to successful agriculture in the arid regions, has yet met with sufficient popular favor to recommend it to our learned legislators at Washington.



JOHN E. FROST,
Land Commissioner A. T. & S. F. Ry, Topeka, Kansas.



WM. H. MILLS.

Land Commissioner, Southern Pacific R. R., San Francisco, Cal.

Litigation That the right to the **Multiplying.** water should become appurtenant to, and inseparable from the land, has long been recognized, but the problem is how to bring this condition to pass. Feeble attempts have been made by the legislatures of some of the States, but the entire series of laws now existant can be said to be nothing more than efforts toward a solution, some of them worthy and many unworthy, and the litigation which is growing out of this chaotic state of affairs has become alarming in its magnitude and disastrous in its effects. And the end is not yet in view even with a long range telescope.

Elwood Mead's Address. The cession by the Federal government of the arid public domain to the States in severalty has again become an issue after lying quiescent for nearly two years. In an able and scholarly address before the American Society of Irrigation Engineers at Denver, December 12, Elwood Mead, State Engineer of Wyoming, carefully reviews the problem of the arid lands and

the water supply. That no extensive and continued or permanent development of our Western States is possible until the control of both land and water is vested in the local government, is the conclusion drawn by Mr. Mead. Even the Carey Law, of which so much was expected, according to Mr. Mead will fail to fulfill expectations and is far from being adequate to the needs. Mr. Mead makes some first-class suggestions as to remedies, and one cannot read his address without feeling that he has thoroughly studied the question of the arid public domain and its ultimate reclamation. Without entering into a detailed discussion of this address (a printed copy of which can be had for the asking) THE AGE wishes to register its endorsement of the cession of the lands to the states and of Mr. Mead's suggestion that a certain acreage of grazing land should be allotted and rented to the man who irrigates. This will do much to lessen the friction between the cattle man and the farmer, and will be unjust to neither.



WASHINGTON HESING.

Chicago's Popular Postmaster, Who Has Taken an Active Interest in the Work of The Homeseekers Association.

IMMIGRATION INTO THE ARID REGIONS.*

By JOHN E. FROST.

WHSOEVER takes up the subject of immigration into the Arid Regions studies the causes which produce emigration from populous regions or congested social centers and those things which attract to the west, where our arid regions are, naturally thinks at once of irrigation as a prime factor in the problem because the word "arid" precludes the idea of rain farming, and farming in some shape and to some extent is a necessity in the successful settlement of the west, and farming without water is a lonesome, not to say dry business.

"Water is the mother of the vine."

"The nurse and fountain of fecundity,"

"The adorning and refresher of the world."

So we must have water in the arid regions and as the clouds refuse to give it, it must be supplied artificially, hence the important bearing which irrigation has upon the settlement of the arid districts.

There are in those regions vast mineral deposits, practically all of the precious mineral deposits of the country, coal fields almost beyond measure and lead and copper in fabulous quantities and, of course, the development of these resources, the mining, handling and shipping of these minerals will attract and support a large population, but in order to bring this about quickly, development must be accelerated and greatly increased, and farming operations in commensurate proportions must accompany this development. The miners, the engineers, the mechanics, the operatives of the smelters and stamp mills and employes in all lines allied to those interests must have farm products at living prices. At the inception of mining camps and for a time in their early history while great excitement exists very high prices for all farm products prevail, but if growth is to continue, if the camp is to become a permanently prosperous, substantial and progressive region, these prices must drop

*Address on "Immigration into the Arid Regions" delivered by Mr. John E. Frost, Land Commissioner of The Atchison, Topeka & Santa Fe Ry., at the Fifth National Irrigation Congress, Phoenix, Arizona, Thursday, December 17th, 1896.

to a reasonable basis, and to bring this about the bulky and heavy farm products must be produced within a reasonable distance, and this fact necessitates irrigation ditches all over this vast arid domain and renders possible, with prudent management, their success as financial ventures. The fact that so many irrigation enterprises have been unprofitable proves only that there is something wrong which can be remedied. I think that the failures, except in cases of gross blunders or dishonesty, have in practically every case been due either to inability to control the land under them, or where the land was controlled, to holding the land and water at too high prices. Successful irrigation systems offering land and water at reasonable prices, will undoubtedly attract settlers to the arid regions, hence an important step towards the peopling of these districts is such modification of public land laws as will encourage irrigation enterprises by enabling them to control a solid body of public land under their canals, and thus inseparably attach the water to the land. The self-interest of the owners of the enterprise will do the rest. They will have to sell land and water at such prices as will tempt farmers to buy or they will be forced into bankruptcy and a receiver will do it for them. The Carey law is found to contain serious defects and should be amended and the desert land law should be repealed.

The recommendations and influence of this body will undoubtedly have weight with the U. S. Congress and careful thought should be given to decide upon such recommendation of changes in the public land laws as experience has shown to us in the west to be needed, under the changes in colonization and settlement of the past few years, and proper action upon these lines will undoubtedly have great effect upon immigration to the arid regions.

In order to secure immigration, we must be able to provide settlers with the means of making a living. The develop-

ment of a new mine, the enlargement of operations of an old one, the construction of an irrigation canal, all attract new people to a new country, and if the employment be of a permanent and remunerative character, then the settlers whom you enlist in it become permanent residents. They soon have families about them, become identified with the country and its interests and assist in bringing others in, and in this connection let me say that few influences are so potent in bringing settlers into a new country as letters written by its own people to their friends "back East" telling how prosperous they are and how good and abundant are the opportunities for others to share in their prosperity if they will come out and take advantage of the openings presented. But an important adjunct, a large part of the basis for all this, is capital to initiate and develop these industries which are to bring and sustain the population that we want. Ninety-five per cent of the population of our country is out of balance. Its geographical subdivision is out of harmony with its centers of population and finance. What you in the arid regions want to secure a fairer population is to pave the way for it by enlisting Eastern capital in the development of your natural resources. We people of the West have not the necessary capital; we are poor, that is poor in pocket, although rich in our minds when we think of the vast possibilities in our grasp, of the latent wealth of the West which can be made to respond to the application of the idle capital of the East. The respective needs of the East and the West are correlative and must be brought together to minister to each others fulfillment. In the East is a superabundance of capital eager for investment, a large and rapidly increasing population massed in overcrowded business centers. In the West millions of raw material calling for development as loudly as anything inanimate can call, and room for all the surplus population of the world. Capital, if assured of safe investment and a satisfactory return of profit, will quickly flow to the regions which promise these things, and immigration and growth will accompany and follow it. What can we of the West do to accelerate and secure this desired movement of capital and population? In the first place, the thing of prime importance is for us to show by our legislation

and by all our utterances, that investments of non-residents will be as adequately protected by law in the West as in their own home localities. With that principle as a starting point, we then, in our respective localities, have but to convince the owner of idle capital desiring investment that the investments we present are inherently safe and can fairly be relied upon to produce much better returns than those at his command elsewhere, and to convince the intended immigrant that we can offer him better opportunities for improving his present condition than can be found elsewhere, in order to secure the capital of the one and the presence of the other. Great aids in this work are state and territorial agricultural societies, bureaus of information and other similar boards, whose duty it is to collect and publish in periodical reports reliable statistics covering the agricultural, mineralogical and other great interests of their respective regions. These reports are invaluable, both for direct use with intending investors and settlers, and as affording data for advertising matter issued by investment companies and others presenting investments, and descriptive of special localities, pamphlets which are disseminated through thousands of agencies. In my work of the past twenty-five years in selling and settling lands of the Santa Fe Railway and subsidiary companies, I have made constant use of such reports. Agricultural colleges, with their attendant experimental stations, state and territorial universities and technological institutes which obtain information respecting the resources and advantages of their fields of labor and instruct how best to utilize them, are important agencies in building up the country and attracting settlement, and should have our heartiest support. Each one of their graduates becomes an intelligent, and in proportion to his ability, a more or less influential missionary in this work, so that their influence is constantly widening.

Local boards of trade and commercial clubs are excellent auxiliaries to immigration work, and local newspapers are powerful forces in this work. Special editions descriptive of special regions, with good pictorial illustrations of attractive and interesting features, are valuable. Your home people send them to the old home friends, and through various avenues they

can be made to reach and interest a multitude of people in the East. Many who now rank as old settlers out here got their first impulse to move West from some such publication.

Our church organizations are powerful agencies in peopling the West. Their work in its various lines goes on so quietly that we come to think of it as a matter of course and scarcely realize how potent a force it is in this connection.

One of the most impelling causes of immigration to the West hitherto has been the vast body of public lands open to homestead entry and the considerable area of railroad grant lands for sale at low prices in the rain belt regions west of the Mississippi river, but the situation is now changed, these lands are now practically all gone, and although Uncle Sam's public domain still embraces, according to the recent annual report of the Secretary of the Interior, six hundred millions acres outside of Alaska, the seeker for a free home now must invade the arid or semi-arid region to obtain the national heritage. Secretary Francis urges upon Congress the need of legislation for the reclamation and disposal of lands within the arid regions and suggests amendment of the Carey law, or placing the lands under the direction of the states, only so far as may be necessary to secure their reclamation for the benefit

of actual settlers. Hon. J. Sterling Morton, Secretary of Agriculture, in his annual report, states that the exported products of American farms during the last fiscal year increased \$17,000,000 over the preceding year, and asks why a nation possessing, as does the United States, the greatest power and facilities for producing and manufacturing things which the world demands, is not destined to monopolize the markets of the globe. President Cleveland, in his message to Congress just uttered, says that the number of foreign immigrants arriving at our ports during the fiscal year shows an increase of 84,731, or nearly 33 per cent. over the previous year.

So the necessities of the times touching the disposal of public lands, the increase in the market for American products, the revival of foreign immigration to the United States, the overcrowded condition of the East, the absorption of the rainbelt districts of the West, all render the present a most favorable period for this body, through its work and influence, to secure now such legislation as will result in the undertaking of irrigation enterprises that will soon place under ditch a great area of public land that is now worthless, and no other action that could be taken would do so much to stimulate immigration to the arid region.



AN IDAHO HOP YARD.

IRRIGATION IN THE EASTERN STATES.*

BY F. H. NEWELL OF THE GEOLOGICAL SURVEY.

IRRIGATION is as wide as agriculture, and not only enters into the diverse branches of cultivation, but also is found in one form or another in nearly every locality where crops are raised. It cannot be shut off by itself as pertaining to a particular climate or locality. There is probably not a section of our country where the artificial application of water to the soil is not successfully practiced, despite the wide range of climatic conditions. Even in cold, damp New England the meadows and grass lands are in some instances watered by systems of ditches; orchards are thus occasionally protected from drouth, and cranberry marshes are flooded, the method of applying water differing little from that in use in the arid states. Coming southerly along the Atlantic coastal region there are to be found small farms, especially in the vicinity of cities, where irrigation is habitually practiced. This is notably the case in truck farming in the light, early soils. For example in the Carolinas and Georgia, where early vegetables are raised for the New York market, it often happens that there is a deficiency of rainfall just at the time when the vegetables should be making their best growth or are maturing. Unless water is then applied losses of hundreds of thousands of dollars are imminent, but with proper moisture given at the right time large profits can be secured.

The flooding of rice fields, though so well known, is often overlooked as belonging to this class of cultivation, but it is properly included under the term "irrigation," as well as all means by which the supply of water is artificially regulated, even though this is in part closely allied to draining. The same kind of problems are encountered both as to lifting and conducting water and also as to the effect on the plants of a surplus or of a deficiency of supply.

Within the Mississippi valley and even

up into the far north in Wisconsin and Minnesota are many fertile soils of a texture such that they do not retain moisture. As a rule water can be found below these at depths often under twenty feet and can be cheaply raised by suitable machinery. The experiments of Prof. F. H. King at Madison, Wis., demonstrate the great increase of crops by the use of water thus obtained.

If we include under the term irrigation the watering of lawns and gardens from city and town supplies, we will have a larger appreciation of the extent to which this method of agriculture is practiced and found invaluable. There is hardly a place of any considerable size where the home surroundings are not made more attractive by the lavish use of water on the grass, trees, flower beds and gardens. These form the best object lessons as to what can be accomplished by the employment of plenty of water at the right time. A corresponding luxuriance of growth can be obtained by field crops under like conditions. Let the farm be supplied by gravity systems, or by pumps or storage works so built that it can receive at moderate cost a large enough quantity of water when needed, and the farmer can with due intelligence and energy rival the prize crops and be sure of large returns, whether the rains come or not. In the deliberations of the Irrigation Congress we must recognize the east if we claim to be national in character. To maintain the larger relations we should meet occasionally farther to the east than before, and show a proper interest in development in all parts of the country, whether the climate be humid or arid, co-operating with all other agencies seeking to promote a larger and better use of the national resources in soil and water.

* Extracts from remarks before the Fifth National Irrigation Congress.

THE ART OF IRRIGATION.

CHAPTER XVIII. THE AMOUNT OF WATER REQUIRED.

(Continued)

BY T. S. VAN DYKE.

WHILE the acre foot is the best way of estimating the amount of water used in irrigation, because it counts the water actually put upon the land as shown in the last chapter, there will still remain a great difference in the quantity used in different sections and by different irrigators in the same section, even side by side and for the same crops. And each one will be quite positive that his way is the best, while many will claim that they are cheated out of some water even if they use a foot to the acre.

The extremes of the use of water seem a cubic foot a second to about eighteen acres on the Rio Grande about Albuquerque, embracing all the lands under the old ditches for miles above that point and some below, to a foot to about two thousand acres at Pasadena in Southern California. Pasadena has an average rainfall of about eighteen inches, most of which enters the ground, while on the Rio Grande it is practically nothing. But this does not begin to account for the difference. Both these estimates are made by dividing the acreage served by the amount of water in the aqueducts. Both the acreage and the amount of water are subject to some errors from measurement, but not enough to affect the result very much. And as all other ditches in the land are in the same condition, as far as knowing exactly the amount of water or land, these are as good data as can be had.

WATER FORTY FEET DEEP.

The ridiculous nature of the irrigation on the Rio Grande is seen in the fact that a foot a second would in a year cover eighteen acres about forty feet deep. But counting only by the irrigating season of say six months, only half that would be put on. But this would be twenty feet in six months, or forty inches in depth per month. Allowing as much as ten percent.

of waste at the lower end of a tract to insure good wetting of that part, and we still have thirty-six inches, which would be a larger rainfall than any part of the United States has during the whole growing season, and would be equal in effect to twice that amount of rain as it usually comes. This is three acre feet a month, or more than some of the best irrigating sections use for the whole year for anything but alfalfa, and more than most of the prosperous alfalfa sections use during the six months of summer, five feet for the whole year being about the outside figure for those who make any extensive business of it and understand it the best. This estimate of the duty of water on the Rio Grande was made with much care by an engineer of that section for his own information, was stated in a paper read to the Irrigation Congress at Albuquerque, and was considered correct by those there best qualified to criticise it. It is instructive for three reasons:

It shows the absurdity of taking the duty of water in that way.

It shows what progress may be made in irrigation in four hundred years by people who do not travel and study what other sections are doing.

THE MISTAKES MADE.

It shows what a big fool the great American citizen of the tenth decade of the Nineteenth century can be, for all up and down the Rio Grande, where he is trying to irrigate at all, he is following very closely the old methods of the first Indian settlers, without the slightest suspicion that any other part of the United States has learned anything of late years. When you look at the region under the ditches along that river you will not wonder that Mexico is clamoring for the water that used to come down to the line. Thousands of acres of the most fertile land, under a

splendid sun, for growing almost anything that can be grown at that elevation, are alkali'd almost to the point of being worthless; thousands more have the crops drowned or overgrown with weeds that grow while the crops are held back by the drenching. Everywhere in the irrigated sections you find bog holes and sloughs in the roads made by the water wasted from the fields. In some places the crops on well drained ground are good enough to show what they might be if properly treated. Nowhere are they better than that. Everywhere there is waste and muss and ruin enough to sicken anyone who knows what good irrigation is and knows what that fertile valley could yield if water were properly used.

THE EXAMPLE OF PASADENA.

The case of Pasadena is almost as bad on the other extreme. I know places where even less water than a foot to two thousand acres is used, but they are scattered patches and do not afford as good an instance as Pasadena, because that is under a land owners' company where the distribution is well managed and is a solid and flourishing city of some fifteen thousand people. It is instructive, not as an example to follow, but for the principles involved in the showing it makes on so small an amount of water.

Pasadena started some twenty years ago as a small settlement for the growing of oranges and other fruits, some nine miles from Los Angeles, California. A small but quite reliable supply of water was flowing all the year in Arroyo Seco above the settlement, but not supposed more than sufficient for a thousand acres or so. The beauty of the situation and the success that attended the cultivation of the orchards before the great boom set their owners crazy and made them cut many of them into town lots, increased settlement and extended the area very rapidly. The water supply has been constantly increased at times, but was entirely unable to keep pace with the rate of settlement, which went ahead in spite of the collapse of the great boom. It is now a beautiful city with hundreds of fine places, and though it can no longer be called a productive place, as compared with other settlements, there are still hundreds of orchards that

would produce very well with a little more care. At a time when its water supply was not over a foot a second to fifteen hundred acres, measured by the year, or an inch to thirty acres, the orchards repaid their care, though by no means as profitable as they might have been with more water. They looked fine, and to the eye of a stranger there was nothing lacking. To the eye of an expert or fruit buyer there was a considerable shortage of the higher grades. Nevertheless they were unquestionably profitable for several years where carefully managed, and especially where the owner did as much of his own work as possible. Now, with even less water, the orchards look well to a stranger's eye, and most of them now pay interest on a valuation of several hundred dollars an acre, where the owner takes good care of them and does his own work.

MOISTURE RETAINING SOIL.

But it must be remembered that the winter rainfall is here heavy enough to raise good crops of corn on the upland, with every grain planted after the last rain, and the soil is so retentive of moisture that with cultivation alone good crops of deciduous fruits are a certainty in most years. The general yield is much increased by irrigation, which is indispensable to any marketable crop of oranges, but it is still so far short of what it should be as to prove it folly to try to work the soil for profit where the water is so limited, when there are so many other places where there is plenty. If you want profit go where the water is. Yet this place proves plainly the folly of drenching the ground continually.

It is certain that with double the amount they now use, or three-quarters of an acre foot, instead of about three-eighths, they could raise everything except oranges, lemons and alfalfa with the highest success. With an acre foot they could raise these three very well, and with a foot and a quarter make a fine success of them, reaching very near the highest with a foot and a half. Two feet for the oldest and most heavily laden trees would be ample. The irrigation is now generally limited to basins, because there is not water enough to give heads large enough or long enough for flooding or furrows. By good culti-

vation this is made to do the largest amount of duty and makes the whole an instructive study, though not a good model for one who wants money first and beauty afterward.

BETWEEN THE EXTREMES.

Between these two extremes there is a wide range of cases quite as useless as guides. On the one hand we have the man with a windmill and some wonderful spring or artesian well who is trying to spread the scanty supply over as large an area as possible. He always has "All the water I want." If he has some dry land to sell outside he is sure to have more than he wants, and discourses very learnedly on the evils of too much water. He will lie most grandly about the profits he makes, or if he admits there is no profit in it it is the fault of the market, of the railroads, or the middlemen, or anything but want of water. On the other hand we have the man who has to pay so much a year for his water any how and is trying to get his money's worth, with a dozen of the other varieties of human nature that the ownership of land under a ditch develops, the principal one of which is to want all you can get and a good deal more, and to run it over the ground if it won't go in, so as to be sure you have got so much ahead of the other fellow who claims a right to some of it. Then charge this waste up against the duty of water and depreciate your section by making capital believe that hundred-dollar-an-acre water is indispensable to success on land that won't bring seventy-five dollars after the water is brought to it.

IMPORTANCE OF SUBSOIL.

From what I have said about winter irrigation, the soaking of the ground by long and heavy winter rains and the influence of such soaking on the crops even eighteen months ahead on lands having a very deep and spongy subsoil, it must be plain that the duty of water will depend very greatly on the nature of the subsoil and the condition of moisture in which it is kept. A dry and uncultivated piece of ground will take out the moisture from an irrigated piece adjoining it with surprising rapidity for several feet past the line of junction. A dry subsoil will act in the same way. If two feet of soil are wet by a flooding, but below that the soil is dry,

that dry portion will take away the moisture faster than will the air above. The rapidity and extent of this process will depend upon the depth, texture and dryness of the subsoil, but it will in any case be rapid enough. This difference is plainly seen now in Southern California. It is now passing through the summer after one of the dryest winters on record. Two years ago it was about as dry. But then good crops of grain were raised all over the greater part of the uplands, while fair corn, planted after the rain was over and never irrigated, was a common sight, though the winter rain had been less than half the average. Now with the same conditions of preceding winter, nothing of the sort is possible. The difference is that the winter two years ago had been preceded by a long series of good winters, none of which were very short, and several heavily above the average. These filled up the subsoil and kept it filled. This last winter was preceded by one a little below the average and that by the dry one above mentioned, so that the subsoil on the uplands is almost as dry as on the desert. Were it not for the great mountains that have so much more rain and snow than the lowlands, this part of California would be in a very bad condition this year. As it is, those who let the winter water run to the sea, because they thought the planting of trees had "changed the electrical conditions," so that this section would be an exception to all the world in having no droughts, will find before the summer is out that their trees will need much more water than they have ever done before. The same thing occurred in 1883, which was the third of three seasons, the first two of which were scarcely up to the average, with a distribution that put little water into the subsoil, while 1883, the last of the series, was much below the average.

There seems no exception to this rule, even along those portions of the seacoast where there is considerable fog at night and the day is never very hot. Moisture in the air undoubtedly effects vegetation, as is plainly seen in the east by the untwisting of the leaves of suffering corn in a rising storm before the rain actually reaches it. Putting water on the leaves has somewhat of the same effect. But these are more in the nature of stimulants or rather like the smell of whiskey to a

dry old toper. They will not help out much of a crop on a dry subsoil.

On the desert many a crop suffers in this way. At the first irrigation, after being dry for ages, it is wet down say four feet. The irrigator thinks this enough. It may be if the sheet water below is near enough to furnish moisture by capillary attraction. But in some soils moisture does not rise in that way one-quarter of the height it is generally supposed to, and in very fine soils does not rise one-half. Sheet water is a fine reliance for many things, if you are sure you have it and sure how high the moisture rises. But until you are positive on this point you had better put into the subsoil all the winter and spring water you can, unless you are certain it will damage the crops. And in irrigating desert for the first time, if it is many feet to water below, you can hardly get too much in. If you should put in two acre feet per month for the whole first winter you might have the top a little too wet for the first crop, but

the succeeding crop would be better than if you had to fight a dry subsoil. When the subsoil is once thoroughly soaked it is quite an easy matter to keep it so. But a dry one is the last thing you want to fight. You can beat the dryest air and hottest sun with water on the surface and good cultivation of the top soil, but if the subsoil is sapping the moisture all the time you have a hidden enemy that is worse than the open ones.

When you have investigated this subject thoroughly you will reach the conclusion that for all around good results a subsoil that will hold moisture—not water but moisture—is very essential to the best cultivation of the soil for field, garden or orchard, and that its condition needs watching almost as much as that of the top soil. And nothing will so enable you to get along with little water at the time of year when it is scarce like keeping this well filled at the time of year when water is plenty and no one wants it.



THE LARGE CANAL, PECOS VALLEY SYSTEM IN NEW MEXICO.

THE FARMERS NICHE IN OUR CIVILIZATION.

BY W. C. FITZSIMMONS.

EVERYWHERE and in all times the husbandman has stood as the corner stone of individual progress. Upon his broad, unwearying and patient shoulders has been upreared the industrial fabric of the world. Amid all the vicissitudes of individual and national life and advancement the farmer has ever remained and still is the indispensable factor, without whose arduous and unremitting toil human society cannot exist. At the gateway of all possibilities in human achievement stands the farmer, and without his consent and co-operation the chariot wheels of progress must stop. From the soil all things must come; to the soil all things must sooner or later return. While all this is true, it is equally true that the farmers have never yet, as a class, taken rank in the modern scheme of things in accordance with their importance and relative value. This is as true in the United States as in other countries, though perhaps in lesser degree. The agricultural classes have been slow to assert themselves and others have traded to their own profit on the modesty of the farmer. Although outnumbering any other class of workers in this country, the farmers have been so long accustomed to allowing others to dictate to them in nearly all things relating to their own interests, that any self assertion has come to be branded as an impertinence by men of other avocations, and even by many of their fellow workers on the farm.

That there is evidence of a coming radical change in this respect is hopefully admitted, although the awakening is late, and less thorough than it should be. Other interests representing commerce, the law, medicine or divinity, are not slow to assert their importance in any and all places, and each takes an especial care to hold a patronizing attitude toward the tiller of the soil. Even the farmers themselves contribute to the prolonging of this condition by meekly submitting to the dictation of nearly all other classes of men, in matters pertaining to politics, business

and social conditions. The man who spends most of his time sitting upon a cracker barrel, but sells a few pounds of cheese and sugar, or a basket of eggs occasionally, as proprietor of a country grocery, is a "business man," while his neighbors are "merely farmers." These may seem trivial affairs and so they are; but just the same they represent a condition which the educated American farmer should have the courage and spirit to persistently and effectually resent. The dignity of his calling should always be defended and insisted upon, but his own relation to his pursuit should not be such as to render his protestations ridiculous. The schoolmaster who should express pride in his avocation, in ungrammatical phrase would merely excite a smile, and the doctor who should extol his skill while attending his patient's funeral would scarcely add to the public respect for his profession. The weed-grown farm proves a bad text from which to preach reform in the national finances, and tumble-down buildings and fences are no argument in favor of sending farmers to Congress. To be brief, the American farmer needs more education, more intelligent devotion to his pursuit and then more self assertion.

He should first know his own business thoroughly and then allow no man to dictate to him in relation to it.

At present all farmers depend upon some one else to tell them the value of their commodities. A farmer enters a store and inquires the price of sugar or calico. He also asks what the merchant will pay for potatoes or pork. It is probably not too much to say that right here is the weak place in all agricultural pursuits. The very fact that the farmer allows another to fix the value, not only on what he has to buy but what he has to sell also, accounts, in large measure, for the condition of comparative dependence in which the farmers find themselves. We hear much of the "independence" of the average farmer. It is a myth. The farmer might be, but is not independent.

As above stated, if he wants a pound of cheese he asks someone else what he must pay for it, and if he wishes to sell a dozen of eggs he asks the same man what he must take for them. American farmers must rise above this condition or they will never command a proper place in the business, social or political world.

How are they to do it? It is always easy to criticise a state of facts, but not always easy to suggest a remedy for it. But certainly a road is open to the American farmer and it is as clear as a turnpike. Do business on the farm in the same careful manner that it is carried on in the store or the factory. Know the cost of every article produced, and know what it should be worth in the markets, taking into account all the conditions affecting its production and sale, as the amount produced, cost of transportation, and all the other factors of a problem which can be as easily solved by the farmer as by the merchant, if the former will but devote the necessary time and talent to its accomplishment. The example of the men who plowed under a part of their wheat crop, in Kansas, in order to increase the price of that staple has been previously cited in these columns. Such a performance, though infinitely puerile and absurd, is, nevertheless, a most excellent object lesson showing the petty provincialism of some farmers who have the unhappiness to believe themselves well informed. Some wag years ago related an amusing anecdote of the late Horace Greeley, which of course was not true, yet seems to show the kind of wisdom that sometimes commands a premium even among farmers. The story was that a young man wrote to Mr. Greeley from Colorado asking him to recommend a proper course to be pursued in improving the breed of his sheep. Mr. Greeley promptly replied that the young farmer should import a good hydraulic ram from Vermont for that purpose.

The main purpose of this article is to impress upon the American farmers the important nature of their calling and to suggest ways and means of properly upholding the dignity which by right of its essential nature belongs to it, especially in the United States.

Don't plant onions on ground where potatoes were grown the previous year.

Prof. Roberts says, "I would as soon deposit \$50 in a bank week after week, knowing that no account was kept at the bank, as to run a dairy without knowing how much each cow gave me and how much it cost me to get it."

The continuous soaking of land or crop is sure to result in injury. One cubic foot of water per second will cover an acre one inch deep in an hour.

Remember that wherever water can be obtained there trees can be made to grow. The irrigated farm should be the most beautiful.

The mountains are full of snow, the rivers of water, the East of capital, and the farmer ought to be full of hope.

A patch of sweet corn makes one of the best crops to grow to commence feeding hogs intended for an early market.

In market gardening don't try to grow too much; the result is always poor vegetables and half a crop.

One cubic foot of water a second is the same as $7\frac{1}{2}$ gallons every second, or 450 gallons in a minute.

Don't try to farm more acres than you have water for. Give irrigation a fair chance.

Before the end of another year the rain-belt farmer will admit that he "ain't in it."

Alfalfa and small grain make a winning team anywhere in the irrigation empire.

Tobacco thrives well on irrigation.

WHAT IRRIGATION DOES.

Irrigation

Reclaims arid wastes.

Makes a prosperous country.

Insures full crops every season.

Is the oldest system of cultivation.

Increases the productive capacity of the soil.

Destroys insects and produces perfect fruit.

Creates wealth from water, sunshine and soil.

Makes the farmer independent of the rainfall.

Will redeem 100,000,000 acres of arid and desert lands.

Will yield support to 50,000,000 population.

WILL CAPITAL BE TREATED FAIRLY.

-BY D. W. ROSS, OF IDAHO.

UPON the theory that the federal government will not build many irrigating canals for us during the coming year, a few reasons why our next legislature should continue the good work along the line of irrigation legislation begun by the last will perhaps not be out of place at this time.

For several sessions past bills have been introduced for the regulation of the use of water for irrigation, but they were of local character, and no general scheme for ownership and control was proposed until the last session, when a law similar in character to the "Wright law" of California was enacted.

The principle of common ownership of land and water was also incorporated into the act passed at the same session, accepting the grant of one million acres of land from the United States. Thus the foundation was laid, it was hoped, for future legislation.

Several "districts" were formed under the "district law," but owing to doubt as to the decision to be rendered by the United States Supreme Court on the validity of the "Wright law" all work was held in abeyance.

All right-thinking men, however, have agreed that we have started in the right direction, and with a few amendments our irrigation laws should be operative for great good.

In answer to the pertinent question, "Will capital be treated fairly?" I desire to explain operations under our "lack of system," which, I trust, will convince thoughtful men of the necessity of a radical change in our present policy, a policy which has retarded settlement and which threatens the good name of the state.

The "promoter" has always been an important man in the development of new countries. In Idaho the "Irrigation Promoter" has held undisputed possession of the field of irrigation enterprise. No laws have yet been passed circumscribing his actions, but he has stood before our legislative committees and in the name of "capital" has objected to every class of legisla-

tion on this important subject. Starting with a proposition based upon wind and water, the water belonging to the state and the wind his own, he has succeeded in making more colossal failures than any other public figure.

Two important reasons will account for such failures. First, he attempts to arbitrarily establish certain relations between the land owner and his water company; to this the land owner objects; and second, in a few cases, the project has been wrecked because the promoter tried to make his profit out of the capital, which necessarily passed through his hands during the construction of the works. While there are a few successes due to his fairness and honesty, the above reasons will account for most of the failures of irrigation enterprises in this state.

The promoter has been given a free hand, his reports in many instances will not stand investigation, and, taking into full account "hard times," the policy adopted through his representations promised nothing but disaster. Yet he has been abetted by many prominent citizens on the plea that we will reap great advantages through the "expenditure of capital." In the attempt to mitigate the wrong done capital all manner of colonization schemes are placed before the people, which in many cases have only added new victims.

There has either been an exception to the proverbial "timidity of capital" in the case of irrigation investments, or the irrigation promoter is the prince of charmers. In all large undertakings of this class capital is absolutely necessary. It is generally supposed that capital's first inquiry is regarding the security offered. Whether the profits of the promoter be great or small, whether the relations between the management and patrons be cordial or strained, is of but little moment to the holders of the bonds, provided the security for said bonds is good.

With the constitution of the state before him, which declares the use of appropriated waters to be a public use and within

the control of the public, without the adjudication of a single right on the stream, without a contract signed with a single land owner, the patron of the proposed company, with a duty for water fixed arbitrarily, the promoter has induced capitalists to expend millions of dollars in these enterprises, many of which can only promise loss.

In every case the security for bonds rests upon the toil and thrift of the land owner, but between the owner of the land and the owner of the bond an understanding does not exist. They have not yet met.

The *title* and *right* to water under our constitution rests in its *use*. The value of the security for the capital invested in the works also depends upon the use of the water, for the carrying of which the works were constructed.

When the ownership of the works are vested in a company and the ownership of the land to be watered in numerous individuals the plan of operations has always been about as follows: To demand a subsidy from the landowners, the amount and conditions of said subsidy to be fixed by the owners of the works. This subsidy is known as a "water right" which by its conditions places a perpetual obligation against the land in the shape of a fixed annual cash rental for water, in many cases whether water is used or not.

It is generally expected that this amount received for these so-called water rights would at least pay the first cost of construction and handsomely pay the promoter if he has not already taken his profits from the proceeds of the sale of the bonds.

This is the outline of a well-known plan of procedure on the part of the promoter of the enterprise and this nicely put upon paper is the security offered for bonds.

The only element lacking to make this a gilt-edged security is the consent and co-operation of the landowners, by whose thrift alone can the bonds become a good investment. But the landowner is not a party to the bonds, the mortgage being against the works and not the land. The so-called water rights which have been paid for in full being released from the mortgage, adjustment of rates being within the jurisdiction of the courts and the constitution of the State declaring that use of the water entitles the landowner to

a continued use of it, the query is who will pay the bonds?

It is hoped that under our new laws the security offered will not be a fanciful dream nor a schedule of net earnings, but the *irrigated land itself* and the pledge for the return of capital and interest will be given not by an impecunious promoter but by every owner of land under the proposed works.

All the readers of *THE AGE* are acquainted with the "Wright," or "District Irrigation Law," and all appreciate the importance of the recent decision of the Supreme Court which declared it valid. Now that this law is operative we hope to make it, First, the means by which the farmers of Idaho may build and control their own irrigation works, and second, afford a perfectly safe investment for capital. Already steps have been taken for the first, and the second will be best effected by placing the entire matter under State control.

When all conflicting rights to public water are properly adjudicated; when the financial and legal status of companies and Districts and the rights of individuals are passed upon by our courts before outside innocent parties are involved; when estimates and plans are approved by the State Engineer before work is begun, then will we invite the confidence of investors, for our irrigation enterprises will be backed by the thrift of the farmer and the integrity of the State.

In this class of legislation as in all others thoroughness in the work of drafting the law is of paramount importance. No emergency exists, therefore it will be best to go slowly.

Let us build upon the foundation principle of common ownership of land and water (which has already been laid), a system perfect in all its details which will guarantee the greatest good to the greatest number, besides offering a security to the investor as good as a *government bond*. Then will capital be treated fairly!

SOME GOOD POINTS.

Have a care in irrigating carrots and parsnips, as they are ruined if water is near them too long. Root crops give the best results by being sown on ridges from three to five inches high. This method insures a larger and finer root.

An orchard once planted will not take care of itself. It must have close attention to every variety of fruit. Remember that you are trying to grow fruit, not wood.

Set the trees in an irrigated orchard so that those requiring the least water will receive the least, and vice versa. The cherry needs the least and pears and apples next, in the order named. It is well to give apples plenty of water the first season after planting. Give the gooseberry, strawberry and currant plenty of water. The blackberry and grape will do nicely with little.

LARGE CANALS IN THE SOUTH.

The Marion Steam Shovel Company have recently made sales of three of their large Ditching Dredges to be used in constructing a canal in the South. Two of these Dredges have sixty-foot booms and very large hulls, with vertical spuds: the third one is for a lateral, and has a forty-foot boom, with their patent bank spuds.

This Company are now very busy on this and other orders. They manufacture a full line of excavating machinery, both Steam Shovels and Dredges, and suitable for all earth displacements. They have the largest and best equipped plant in the United States for the manufacture of this line of machinery. The officers of this Company are men who got their experience from actual work as steam shovel and dredge engineers, having had from eight to twenty years' experience in that capacity. From this experience they were enabled to get the weak and the strong points of all the machines manufactured, and to improve on the strong points and eliminate the weak points from their own machinery. Among their strong claims is that of simplicity of design, as they get the same results with very much less complicated machinery than is generally used. Their office and works are located at Marion, Ohio, and they would be pleased to answer all communications relative to their line of machinery.

HOT AIR ENGINES.

It has been demonstrated in many Western States that the water supply is collected in basins formed by impervious strata, giving an inexhaustible supply of water. All that is necessary to bring the

hidden rivers to the thirsty fields is a method that can be depended upon for swiftness and be sure and steady. A recent invention in pumping engines, with simply hot air for power, insures a supply equal to almost any demand. The capacity of a DeLamater Rider or a DeLamater Ericsson Hot Air Pumping Engine is from 1,500 to 30,000 gallons of water per day, which can be piped to any part of the farm. These engines require very little heat to run them, have no valves, do not require steam and are so safe that a child can run one. The manufacturers will ship an engine to responsible parties subject to approval, and anyone interested should write for catalogue and particulars. Address The De Lamater Iron Works, 467 West Broadway, New York, N. Y.

ELECTRIC POWER STATION.

The new power company at Niagara Falls have now in successful operation their new power plant, consisting of four of the Leffel celebrated Niagara type of Turbines, each of about 2,200 horse power capacity, or giving in all some 9,000 horse power. These Turbines drive eight generators of something over 1,000 horse power each; generators being connected directly to the shaft of each wheel, one being placed on each side.

This comprises the most complete and perfect electric water power plant in the world. The same company have four other of the Leffel Niagara Turbines, using in all eight of that style of wheel.

A GOOD LAND GRADER.

We have received a copy of the new circular for 1897 descriptive of the Shuart Land grader, from which we cull the following sample testimonial:

MOUNTAIN HOME, IDAHO, DEC. 1, '96.

B. F. SHUART, Esq.,

Dear Sir: I wish to express my high appreciation of the Shuart Land Grader. It has made farming in irrigated districts a pleasure. I would not place a price on the one we have were I unable to replace it.

Very truly yours,

A. B. CLARK, Supt.

We advise all irrigators to send for a copy of this circular. For the address, see advertisement of the Grader in another column.

Clover hay, cut fine and cooked or scalded, makes an excellent mess for the hogs, especially if a small quantity of meal be sprinkled over it. The hog should have bulky food as well as the horse or cow. To feed it on concentrated food exclusively will not bring as good results as mixed diet.

BROWN'S RED BARN.

Us folks of Punkin village have had a monstrous loss—
'Twas not a fine-bred Jersey cow, nor any racin' hoss;
For pesky trifles sich as them we wouldn't care, a darn,
But we one and all regret the loss of Brown's red barn.

Of good ole Punkin village 'twas the center and the pride;
'Twas admired for twenty miles aroun' about the country side;
Ole Deacon Tompkins' windmill is a smashing big con-sarn,
But it 'tracted no sich 'tention as did Brown's red barn.

It stood atop of Winnow hill, where neighbor Brown resides,
And letterin' of varus kinds was writ on roof and sides—
For instance, mottoes sich as these: "Try Baxter's pep-ment gum,"
"Please call at Holt's, in Centerville, for fine New England run."

Before that barn was built a train would give jest one short toot,
But sence 'twas built each passin' train has gin a grand salute;
It made the town look city like—its signs and walls of red
Were jest in city style—at least, so city folks have said.

Las' night 'twas burnt to ashes, and I tell ye 'twas a sight—
In town and fields aroun' about 'twas more like day than night;
The Punkin village fire brigade were there and did their best—
They saved the horses and the cows, but couldn't save the rest.

The second-handed injine it broke down within an hour,
And arter that to quench the flames was not in human pow'r;
The hungry flames 'ere mornin' gobbled up the hull con-sarn,
And to-day there's a naught but ashes left of Brown's red barn.
—*Boston Globe.*

OPPOSED GOVERNMENT OWNERSHIP.

The American Society of Irrigation Engineers at its last session in Denver, Colo., adopted resolutions opposing the idea of government action in the building of irrigation reservoirs and canals, but advocating a government commission to look over the arid territory and make suggestions for the aid of the states in the work. The permanent headquarters were established in Denver.

LITERARY NOTES.

McClure's Magazine will begin in the January number a series of "Life Portraits of Great Americans" with reproductions of all the existing portraits of Benjamin Franklin known to have been made from life. There are fifteen such portraits, and some of them have never

been published. Mr. Charles Henry Hart, probably the highest authority on early American portraits, is collecting and editing the material for the series, and will add introduction and notes giving the history of the several portraits and whatever is interesting in the circumstances of their production. There will also be an article on Franklin by Professor Treat, of the University of the South.

Scribner's Magazine began with January, 1887. The issue for January, 1897, celebrates the opening of a new decade. A great programme has been announced for the coming year, and several of the series will begin in the January issue—notably the series on "The Conduct of Great Businesses" beginning with "The Department Store" described by Samuel Hopkins Adams, of the New York *Sun*, and illustrated from actual scenes by W. R. Leigh.

The Review of Reviews for December publishes a *fac-simile* reproduction of President Cleveland's famous telegram to Indianapolis in September last forbidding consideration of his name as a candidate for renomination. This message has been generally misquoted by the press. It is worded as follows: "My judgment and personal inclination are so unalterably opposed to your suggestion that I cannot for a moment entertain it." The telegram was addressed to the Hon. Daniel G. Griffin, chairman of the New York delegation. The *Review* now presents the original autograph as a "foot-note to history."

The Century Co. had accepted Dr. Mitchell's new novel, "Hugh Wynne, Free Quaker," for book publication, and it was to be issued this autumn. A large edition had been printed and advance orders had been received from the trade, when the strength of the story and its probable drawing power as a serial in *The Century* decided the editors of that magazine and the publishers to suppress the book for a year and use the novel first in *The Century*. Those who have read the story consider it not only Dr. Mitchell's masterpiece, but one of the really great American stories.



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TEXAS.

In the Agricultural line, Texas leads all other states in the variety of its products. Cotton, corn and the cereals grow and are raised in every section of the state and in the central and southern portions, sugar cane and sorghum cane are profitably cultivated.

On the Gulf Coast two and three crops of vegetables are raised each year. Berries are shipped six weeks in advance of the home crop in the north. Pears, peaches, plums, oranges, figs, olives and nuts all grow abundantly and can be marketed from two to three weeks in advance of the California crops. Large quantities of rice are now grown.

If the land seeker, the home seeker and the settler desires to secure a farm larger than the one he occupies, on vastly more reasonable terms; if he wants more land to cultivate, a greater variety of crops to harvest, with proportionately increased remuneration, at a less outlay for cost of production; if he wants an earlier season with correspondingly higher prices; if he wants milder winters, all the year pasturage for his stock, improved health, increased bodily comforts and wealth and prosperity, he should go to Texas.

Send for pamphlet descriptive of the resources of this great state (mailed free). Low rate excursions via the Missouri, Kansas & Texas Railway every month. Address H. A. Cherrier, Northern Passenger Agent, 316 Marquette Building, Chicago, Illinois.

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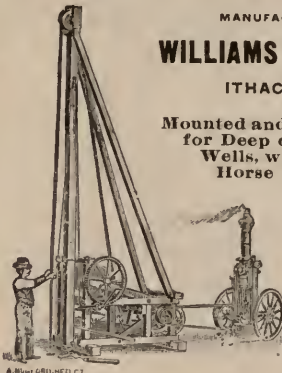
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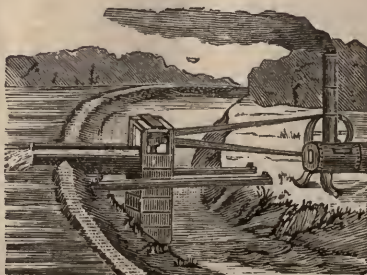
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